
HEBE
Highly Engaging eBook Experiences

HEBE: Highly Engaging eBook Experiences

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I certify that, except where due acknowledgement has been given, the work presented in this thesis is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; and the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program.

Lugano – November 27, 2014

Luca Colombo

Abstract

Despite more and more books are made available in electronic format and technology is increasingly present in children's everyday life, thus far the potential of the electronic book (eBook) medium has been only partially exploited. With the Highly Engaging eBook Experiences (HEBE) project we studied how to design and evaluate eBooks for children with the goal of making the reading experience more engaging.

The project began with an investigation of the many facets that characterize the reading experience of children in order to understand how it could possibly be enhanced by electronic books. In a later stage an intergenerational design team used different techniques of Cooperative Inquiry to explore a range of design ideas. Then, based on those ideas, we developed a prototype of enhanced eBook and elaborated a shortlist of design recommendations that are intended to help designers in creating more engaging eBooks.

The research project ended with a stage of evaluation where children's User Experience with the eBook prototype was assessed. We took inspiration from Csikszentmihalyi's Flow theory to define a benchmark for evaluating the reading experience. Then, by means of the Experience Sampling Method (ESM), we investigated and collected data on the reading experience of two groups of children, one of which read an eBook enhanced following our design recommendations while the other read a basic version of the same eBook. Following a mixed-method approach, with quantitative analysis we verified whether participants who read the enhanced eBook had a better reading experience, while with qualitative analysis we tried to understand why. The results of the evaluation showed that that an eBook designed following our design recommendations may have a positive effect on children's reading experience by making it more engaging.

Acknowledgments

First and foremost, I would like to thank all the children (and their parents) who took part in the project.

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I would also like to thank all the colleagues and fellow researchers who contributed to the success of this research project.

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[1] http://p3.snf.ch/Project-129868

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Chapter 1

Introduction

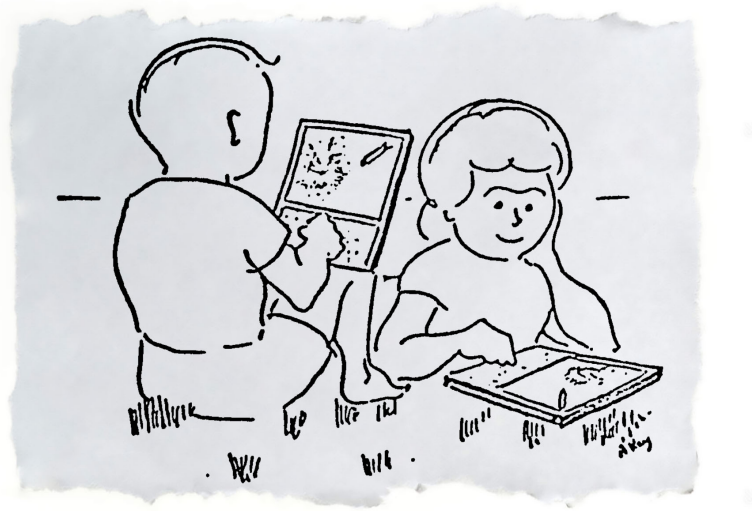

Figure 1.1) Children using Dynabooks in an original drawing of Alan Kay (adapted from Alan Kay [16])

It was 1972 when Alan Kay in his paper entitled *"A Personal Computer for Children of All Ages"* [16] envisioned the *Dynabook*, a sort of ancestor of today's electronic books (eBooks) and electronic readers. Part of his vision was as follows:

> *"[Technology] may, however, provide us with a 'better-book', one which is active like the child rather than passive. […] This new medium will not 'save the world' from disaster. Just as with the book, it brings a new set of horizons and a new set of problems. The book did, however, allow centuries of human knowledge to be encapsulated and transmitted to everybody, perhaps an*

active medium can also convey some of the excitement of thought and creation". [16]

Since then more than 40 years have passed, yet in our – and other researchers' [32] – opinion these horizons and problems have been only partially explored and addressed. As a matter of fact, despite the exponential growth of the eBook market and the familiarity children have with technology, for the time being most eBooks are just a digital transposition of their paper counterpart and we feel that the potential of new reading devices – such as tablet computers – has yet to be fully exploited.
The goal of the research project we will describe in the coming chapters was to *design a prototype of a children's eBook that could create a better user experience, specifically an eBook that could result more engaging for young readers.*

1.1 Background and Context

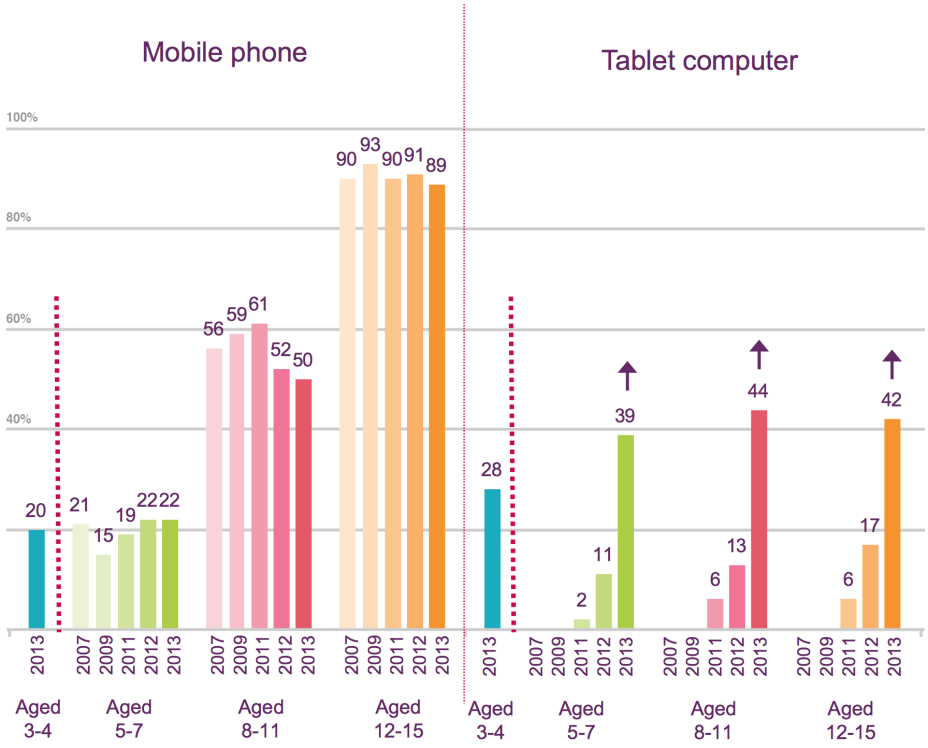

Figure 1.2) Media used by children at home, by age; years 2007, 2009, 2011, 2012 and 2013 (adapted from Ofcom's report [26]).

Nowadays digital technology is an integral part of our everyday life. We interact with a multitude of digital devices over the course of the day, in a variety of situations and contexts. Children in particular, are avid mobile technology users. As a recent report on children and parents' media use and attitudes [26] showed, 50% of UK children in the 8 to 11 age range now use a smartphone at home, and the percentage of those who use a tablet computer is only slightly lower (44%) (see Figure 1.2). The figures related to United States are even more significant: we can learn for instance that 75% of US children aged 8 and under have access to some kind of mobile devices at home [6]. These numbers clearly indicate the extent to which smartphones and tablets are now present in children's lives and why it is important to investigate children's interaction with such devices.

Widespread diffusion of mobile devices, among other things, is transforming *leisure reading* practices [24]. Electronic book (eBook) readers, smartphones and tablet computers (tablets) with their high portability and their cutting edge displays made electronic reading (eReading) of long digital texts – such as novels or narratives – easier, and this contributed to consolidate the eBook phenomenon. According to Wischenbart's "Global eBook" report [34] in 2013 in United States (US) and United Kingdom (UK) – the two largest eBook markets – eBooks have reached a market share of around 20% of trade sales – which goes up to 30% for fiction eBooks. According to the same report, US and UK eBook markets are now mature, and eBooks are transcending their initial niche in a number of countries in continental Europe. However, despite the global spread of eBooks and related technologies, there is a gap in the empirical research on digital leisure reading practices [14] thus it appears that more research on the topic is needed, *"especially research that focuses on children reading eBooks for pleasure, and the opinions and preferences of children"* [32].

1.2 Problem Statement

Even though eBooks are now more popular than ever, we feel that there is still a lot of room for their improvement. Most of the eBooks available on the market are nothing more than digital facsimiles of printed books, which have lost the quality and the affordances of paper but have yet to acquire the extra value provided by the new media they sit upon. Therefore we deem that there is a lot of work to be done in order to make eBooks stand on their feet and take full advantage of the potential of digital technologies. Human-

Computer Interaction (HCI) researcher and practitioners should identify new models for the design of eBooks and further explore reading in its many forms and implications.

While lot of research has gone into studying how adults interact with eBooks (we will come back on this in Chapter 2) children eReading experience have yet to be properly investigated. In most of the cases children's eBooks are designed following existing guidelines intended for adult readers, and without involving children at any stage of the design process. Needless to say that this approach has many limitations, in particular it is incompatible with the HCI mantra: *"know thy user"* ([33], page 66)

Figure 1.3) "Alice's Adventures in Wonderland" pop-up book. © Robert Sabuda

Besides, children and adults are different not only in their approach to technology, but also in their approach to reading. Children's books – especially those for younger readers – already offer a good example of creativity, interaction and variety in terms of both content and presentation: many of them have special features (e.g. 3D pop-ups, games, even smells! See Figure 1.3) which enable a truly interactive and multisensory reading experience hard to replicate in an electronic version. Very few of the eBooks currently available on the market have the potential to deliver a truly interactive and multimedia eReading experience. In this niche, we can identify two main approaches to the design of the children-eBook interaction. One approach is to design eBooks that try to mimic as much as possible real

paper books. In our opinion this approach has some limits. Trying to digitalize real books is no easy task as digital books often fall short of the affordances of paper: replicating page-flip effect or paper 3D pop-ups on a tablet may make the eBook more aesthetically appealing but per se do not add much to the reading experience (see Figure 1.4).

Figure 1.4) "Alice for the iPad". © Atomic Antelope

Another approach is to design interactive eBooks in the form of *serious games* – i.e. games developed with the intention to be more than mere entertainment (Ritterfeld et al. as cited in [9]). This approach has its drawbacks, too. First of all the original storyline of the book has to be transformed (abridged most of the times) in a storyline suitable to be made into a game, thus jeopardizing the quality and complexity of the narrative (the same reason why some movies based on books are quite disappointing). Secondly, and more importantly, the focus of the experience might be shifted from reading to gaming. This means that a so-conceived eBook may leverage motivations that are disconnected from reading – i.e. reading the eBook in order to play a game. Since extrinsic motivations have been shown to harm intrinsic motivation[1] in many studies [8], an interactive eBook built on game elements, may undermine intrinsic motivations connected with leisure reading. This in turn might encourage children to read only in presence of external incentives connected with the gameful component: right the opposite of the idea that sees the eBooks as a way to motivate and involve children in reading. According to Knaving & Björk "It is possible to argue that if there is no intrinsic motivation, extrinsic motivation is harmless. […] If the user mainly focuses on the game elements, she or he may not have the

[1] We will come back on the intrinsic/extrinsic motivation dichotomy in Chapter 3

chance to develop motivations related to the activity itself that could have supported further involvement." [17]

In summary, in our opinion current eBooks are often poorly designed and the potential provided by digital technologies is only partially exploited. Current approaches to the design of children's eBooks are far from being optimal as they seldom take the final user into account and they often confine the act of reading to an incidental activity. A better approach would be to listen children's advice for what concern the various design choices, and to design an eBook by keeping in mind that the text and the story itself must withstand as the core element of an eBook. These are the two assumptions that guided us throughout this research project.

1.3 Research Goals

Highly Engaging eBook Experiences (HEBE) project aimed at studying how to design and evaluate eBooks for children with a particular focus on how primary school children – 7-12 age bracket in particular – interact with eBooks in a context of leisure reading.

The overall goal of this research was *to design a new concept of eBook that provides an engaging User eXperience (UX) for children* and consequently *to evaluate the UX with an evaluation method tailored for the reading activity and suitable for children*. The hypothesis was that an eBook designed in cooperation with children would increase the engagement of young readers with the text.

In the light of the research goals we just mentioned, these are the research questions that we addressed in this research project:

- How can we design children's eBooks to make them more engaging?
- How can leisure reading experience be effectively assessed among primary school children?
- Which aspects of an eBook may contribute to ameliorate children's eReading experience?

1.4 Significance of the Study

It is generally agreed that leisure reading has a great impact on children's present and future attainments. Teachers and educators often emphasize the

importance of reading for pleasure for both educational and personal development. The benefits of leisure reading are well documented and a research overview redacted by Clark and Rumbold [4] of The UK National Literacy Trust cites overwhelming evidence on the matter, stating that reading for pleasure is positively linked with the following literacy-related benefits:

- reading attainment and writing ability;
- text comprehension and grammar;
- breadth of vocabulary;
- positive reading attitudes;
- greater self-confidence as a reader;
- pleasure reading in later life.

Clark and Rumbold also report evidence that reading for pleasure not only impacts on reading achievement but also increases:

- general knowledge;
- a better understanding of other cultures;
- community participation;
- a greater insight into human nature and decision-making. [4]

Nevertheless, evidence from international literacy studies – such as Progress in International Reading Literacy Study (PIRLS) and the Programme for International Student Assessment (PISA) – suggests that over the last decade leisure reading is in decline around the world and that a worrying number of young people do not like reading [7]. PISA data in particular show a decline in both enjoyment and frequency of reading for pleasure among young readers [7].

We believe that the introduction of technology in leisure reading practices could mitigate if not invert this trend. In fact there is some evidence that children are increasingly engaging with digital text, at home or in school, at increasingly younger ages [30]:

> *"[…] findings suggests that not only are electronic books viable tools to support literacy development in early childhood, but also that specific factors or conditions have the potential to impact outcomes positively or negatively […] Multimedia and interactive features that motivate and engage young readers are influential factors that can potentially influence reading frequency."* [30]

While research on the effects of eBooks on reading comprehension is mixed (as we will see in Chapter 2), it seems that eBooks have a positive

influence on reading engagement and reading frequency. Yet it is not clear which features of an eBook contribute to that: if it is just because of the *novelty effect* [5] of the reading device or if there is more. Our research project contributed to the existing literature by investigating how to design children's eBooks to make them more engrossing, and which aspects actually constitute a source of engagement. Our overarching ambition was to design an eBook that fosters children's motivation for reading and motivates young readers – reluctant ones in particular – to read more.

1.5 Rationale

The definition of a research goal often implies to make a number of assumptions and choices even before the research work begins. With reference to this project, our "a priori" decision was on how to approach and study the interaction between children and eBooks. We decided to take a User Experience perspective [11][2], with a particular focus on the dimension of user engagement.

Our choice was based on the following consideration. Research has been extensively investigated both pragmatic aspects – legibility, speed of reading, text comprehension, etc. (see [20] for instance) – and hedonic aspects – preferences, enjoyment, motivations etc. (see [24] for instance) – of reading on printed books. But, when it comes to electronic books, it seems that researchers have focused their attention only on the pragmatic aspects of reading. As we will discuss more in detail in Chapter 2, very little research has been conducted on the hedonic aspects of the reading experience in a digital environment. We believed that leisure reading – which is defined later in this chapter – had to be investigated using a more holistic approach, from which our choice.

As for the choice to focus on the dimension of user engagement, we can start from the self-evident consideration that reading engagement is often associated with reading for pleasure [7]. Secondly, we agree with Rogers' argument for a shift from calm computing to engaging UbiComp experiences [29]. In her paper she argues for an alternative research agenda:

> *"…which focuses on designing UbiComp technologies for engaging user experiences. It [the agenda] argues for a significant shift from proactive computing to proactive people;*

[2] See also the definition of User Experience provided in Section 1.6 in this chapter.

> *where UbiComp technologies are designed not to do things for people but to engage them more actively in what they currently do. Rather than calm living it promotes engaged living, where technology is designed to enable people to do what they want, need or never even considered before by acting in and upon the environment. […] Furthermore, it argues that people rather than computers should take the initiative to be constructive, creative and, ultimately, in control of their interactions with the world – in novel and extensive ways."* [29]

While we will provide a stronger argument for the choice to focus on the dimension of user engagement in Chapter 3, we believe that initial reflections alone are enough to give the reader a first justification for our approach.

1.6 Definition of Terms

Before proceeding, it is necessary to define some of the terms that will be repeatedly referenced throughout this dissertation. The following list includes words that are relevant to the study and their definition. Some of these terms are common in their usage but different readers may interpret them differently, therefore we deemed important to explain how they should be understood in the context of this study.

Child / Childhood

The term *childhood* identifies the period of time when a person is a *child*, a period of life that begins at birth and ends with puberty.

Research on childhood and child development was pioneered by the Swiss psychologist Jean Piaget, who provided the most encompassing theory on how children's cognitive skills evolve during growth [27]. Essentially Piaget proposed four major stages of cognitive development: the sensory-motor stage (0–2-year olds roughly), the preoperational stage (2–7-year olds roughly), the concrete operational stage (7–12-year olds roughly), and the formal operational stage (12–16-year olds roughly) [27]. Even though contemporary research recognizes that all children develop differently – and each individual may differ substantially from this typical picture – this general characterization remains useful to understand how human beings evolve during the early years of their lives.

The *sensorimotor stage* is a period of rapid cognitive growth. Infant's cognition is heavily dependent on what their senses immediately perceive and their reflexes [2] and they learning takes place mainly through trial and error. This stage is characterized by extreme egocentrism, meaning that children can see the world only from their own perspective, and they cannot realize the existence of other understandings of the world besides their own [27]. The main cognitive development in this stage is the transition from concrete to abstract mental representations of objects (i.e. object permanence) and the emergence of goal directed behavior [27]. Children this age have mostly physiological, love and safety needs; therefore interactive products developed for them should be based on simple concepts, give a feeling of safety and stimulate learning [21].

Children in the *preoperational stage* can mentally represent events and objects and engage in symbolic play. However they are still unable to focus on multiple aspect or dimension of complex problems, they are still quite egocentric and they still struggle to understand situations from other people's points of view [27]. Language development is one of the distinctive features of this stage: knowledge about symbols, letters, words and books is developed. Children start to use more complex grammatical sentences and to develop their writing skills too [21]. Children's attention span is still brief and they may still have difficulty with abstractions [2]. Children this age have a need for stimulation, love and safety, though they are developing a greater need for autonomy; interactive products for this age group should be based on concepts that are not too abstract [21].

Piaget saw the age of 7 as a major turning point; at around this age children make the important transition from the so-called preoperational to the more advanced *concrete operational stage* [27]. From the age of 7 children are better at logical (or operational) thought. They can combine multiple pieces of information by using rules, but they can only apply logic to physical objects (hence the adjective *concrete* before operational). Children begin to learn about classifications and temporal relations, but still have problems with logical forms, for instance, with negations. Language skills develop further and reading skills are acquired [19]. Interactive products for children this age can be more complex and challenging: it should be considered that they become more aware of the age-appropriateness of products and more sensitive to acceptance by their peers [21].

After the age of 11-12, children enter the *formal operational stage*. In this stage cognitive functioning is well developed and formal thinking, abstract thinking, deductive reasoning and logical skills are now acquired [27].

Children can manipulate ideas about hypothetical situations, abstract problems and complexity. Moreover they become increasingly independent of peers and their parents. By now memory capacity is fully developed and the constructive processes used seem to function much like those of adults [19]. Products for this age group can be very similar to products designed for adults [21].

Children-Computer Interaction (CCI)

Children-Computer Interaction (CCI) research field is a subset of the broader Human-Computer Interaction (HCI) discipline, where the intended users or appropriators of the technology (or systems) are children. Human-Computer Interaction *"is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them"* as stated in the ACM SIGCHI[3] Curricula for Human-Computer Interaction [13]

Electronic Book (eBook)

Various definition of electronic book co-exist [28]. A fairly comprehensive one is provided by The Oxford Dictionary of English[4]: *"an electronic version of a printed book which can be read on a computer or a specifically designed handheld device".* In fact electronic books commonly in use today are primarily computerized representations of physical books. They may feature fixed-layout pages or reflowable text-streams that are reconstructed by a software application to resemble book pages on a reading device [3]. Nevertheless, recent advances in hardware technology are contributing to the re-definition of the term. EBooks that combine text with sound, animation, and images and often include text that is read aloud and highlighted (*multimodal eBooks* as defined by Morgan [22]) are rising in popularity, especially those who are geared towards a child audience. According to Schreurs an up-to-date definitions of eBook should include *"any digital object with textual and/or other content which arises as a result of integrating the familiar concept of a print codex with features that can be provided in an electronic environment"* [32]. Schreurs further clarifies this point by providing a categorization of eBooks for children, distinguishing between

[3] Association for Computing Machinery's Special Interest Group on Computer–Human Interaction
[4] http://www.oxforddictionaries.com/definition/english/e-book

basic and *enhanced* eBooks[5]. Basic eBooks are digital facsimiles of print books which offer a similar-to-print reading experience, while enhanced eBooks are digital publications which integrate text with video, audio, and interactive elements (such as puzzles quizzes and games).

Our definition is in line with Schreurs' of enhanced eBook but with an additional (and important) distinction: for us the text and the story itself must withstand as the core element for an electronic book to be considered as such. Therefore in the context of this study an eBook shall be understood as a digital publication consisting of text, multimedia and interactive content, where the majority of this content – i.e. more than 50% – is text. It is far from us to give some prescriptions on the quantitative allocation of an eBook's content – that would also be hard to determine. This definition, although simplistic aims to preserve the idea of an electronic book as something that is meant to be read; as a vehicle of knowledge, excitement of thought and creation [16].

Engagement

The most commonly used definition and conceptualization of engagement is the one by Schaufeli et al [31] who defined it – in the context of work-related activities – as a positive and fulfilling state of mind that is characterized by vigor (i.e. willingness and ability to invest effort in the activity), dedication (i.e. a sense of significance, enthusiasm, inspiration, pride, and challenge), and absorption (i.e. being fully concentrated and happily engrossed in one's work, whereby time passes quickly and one feels carried away by one's job) [31]. Engagement is usually seen as a persistent and pervasive affective cognitive state not focused on any particular object, event, individual or behavior [31].

In the context of user experience with technology – which is more in line with our scopes – engagement has been defined by O'Brien and Toms as *"a quality of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control"* [25]. These attributes may pertain to the user, the system, and user-system interaction and some of them are associated with usability variables of effectiveness, efficiency, and satisfaction demonstrating that *usability* is intricately woven

[5] There is actually a third category, that of "interactive eBooks". However the difference between enhanced and interactive eBooks does not emerge clearly from the paper, therefore for the sake of simplicity we decided to merge the two categories into a single one (i.e. enhanced eBooks).

into the experience of engagement [25] – *"while an application may be usable, it may not be engaging, but engaging applications do appear to have an inherent baseline of usability"* [25]. The same authors further describe engagement as a process comprised of four distinct stages: point of engagement, period of sustained engagement, disengagement, and reengagement [25].

EReading Experience

For the sake of brevity, in this dissertation we will identify the act of reading electronic texts with the term *eReading*. It follows that the eReading experience can be defined as a particular case of user experience where the mediator – i.e. the system that mediates an activity performed by a user – is an electronic text – an eBook in our case.

Leisure Reading

People have multiple purposes for reading a book, from looking for a recipe in a cookbook to reading a novel for relaxation. The first case is an example of *extractive reading*, meaning the primary purpose of reading is to "extract" information from the text. In the second case we can speak of *immersive reading*, a kind of reading that has an end in itself and that we do in order to get enjoyment from it. Extractive reading is commonly related to goal-oriented activities (e.g. working or studying) and often (but not always) driven by extrinsic motivations [4]; on the other hand immersive reading is commonly related to experiential or recreational activities (e.g. figuring out "if the butler did it") and intrinsically motivated [4].

Leisure reading (also frequently referred to as ludic reading or reading for pleasure) is a specific instance of immersive reading, and refers to reading that we do of ourown free will and that typically involves materials which reflect our own choice, at a time and place that suits us [4]. In other words leisure reading involves any instance where the reader has some element of control over text choice and reading context (both spatially and temporally), and where reading is seen as an enjoyable leisure time activity. The fact that leisure reading is usually done for enjoyment does not mean that leisure reading shall not include learning as a purpose, because for many readers the information they learn is an important outcome of leisure reading [23]. This fact is also stressed by Nell, who sees learning as a desirable consequence of leisure reading [24].

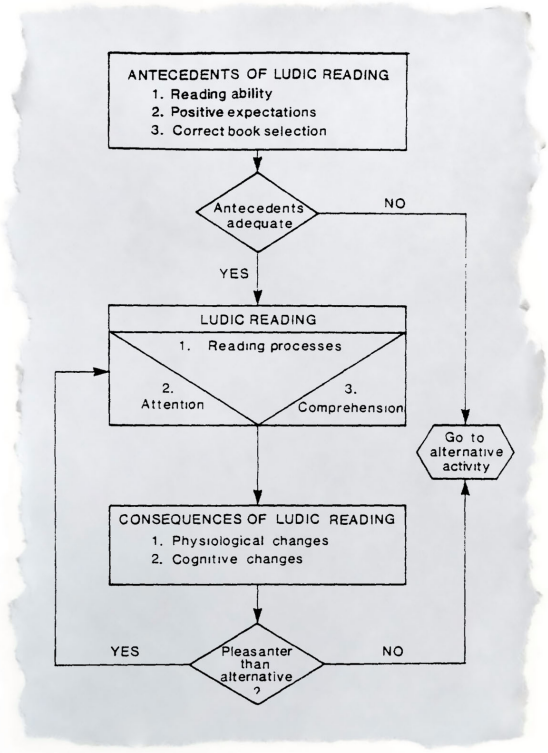

Figure 1.5) Nell's Flow chart of the antecedents and consequences of ludic reading (adapted from Nell [24])

Nell gives a similar definition of ludic reading – which is often mentioned in the literature – describing it as a form of play, a *"free activity"* that *"absorbs the player completely, is unproductive"* and which is *"at root a play activity, intrinsically motivated and usually paratelic, that is, pursued for its own sake"* (page 2 [24]). In the same book he establishes a model of ludic reading (see Figure 1.5) which evidences temporal and hierarchic relations between antecedents of the reading activity *("adequate reading ability, the expectation that ludic reading will be a pleasurable experience, and the selection of a ludic vehicle that provides rewards sufficient to sustain the reading process"* [24]), the reading activity itself, and its consequences (psycho-cognitive state changes *"in which are contained the reinforcers that sustain ludic reading"* [24]).

Tablet Computer

A tablet computer (or simply tablet) is a general-purpose mobile computer where all the hardware peripherals are condensed into a single device. In this

context we implicitly refer to "slate" tablets, meaning those devices that do not have a physical keyboard and where user input is done through the use of a touchscreen display. For this project we use the iPad® 2 tablet, the second generation of a line of tablet computers designed developed and marketed by Apple Inc.

User Experience (UX)

User Experience (UX) has become a buzzword in the field of Human–Computer Interaction (HCI) and interaction design [11]. As an attempt to provide a definition of the term, the International Organization for Standardization (ISO) defined it in the 9241-210 standard as *"a person's perceptions and responses that result from the use or anticipated use of a product, system or service"* [15]; in the same document it is explained that UX includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use. This definition has been criticized by Hassenzahl because it may raise more questions than answers [12]. Hassenzahl emphasizes the subjective, situated, complex and dynamic nature of UX:

> *"UX is about technology that fulfills more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.)."* [11]

A shared definition of the *term* user experience has yet to be identified[6], but the *concept* of user experience as described by Hassenzahl seem to be largely agreed upon in the HCI research community [18]. The tenets that this entails are, according to Bargas-Avila and Hornbæk [1], as follows:

- UX takes a *holistic view* of users' interaction with interactive products;
- UX focuses on *positive aspects* of users' interaction with interactive products rather than negative ones of traditional usability approach;

[6] A collection of 27 (!) different definitions of UX is available at: http://www.allaboutux.org/ux-definitions

- UX emphasizes the situational and dynamic aspects of using interactive products and the importance of *context*;
- UX views and models the quality of interactive products as *multidimensional*;
- UX entails a need for *new methods and approaches for designing and evaluating experience.*

1.7 Organization of the Project

UX design/research typically follows an iterative cycle, consisting in four main stages in which technology is studied, designed, built and evaluated. Harper et al. [10] proposed to extend this design model by elevating the phase of problem understanding – traditionally part of the "study" stage – to a distinct stage labeled "understand" in order to make it a more explicit process (see Figure 1.6).

The goals of each stage[7] can be summarized as follows:

- **Understand** – analyze the design goal; identify the population of potential users; ponder and develop thoughts or theories on what the possible answers/approach could be;
- **Study** – analyze the population of users and the context of use, study how people engage with existing similar technologies and the way those technologies are integrated in their lives;
- **Design** – building on what emerged from the previous phase, explore various creative ideas and develop design concepts that will inform the next phase;
- **Build** – transform the design concept into something real – various techniques can be used, e.g. from low-tech to hi-tech prototyping;
- **Evaluate** – evaluate what has been built, how the users experience it, how it integrates in the real world – if design issues or unexplored aspects emerge, then re-iterate the cycle.

[7] Obviously there are no strict boundaries between one stage and another. Thus, for instance, a design activity can integrate some aspects of the "study" stage or overlap with the "build" stage.

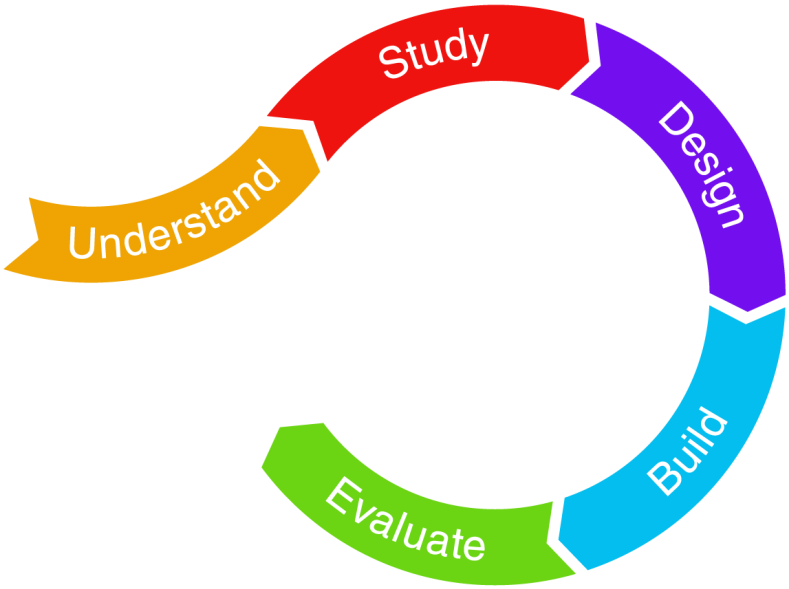

Figure 1.6) The Extended user-centred, five-stage design/research model. (adapted from Harper et al. [10])

The work conducted within this research project was organized following the above-mentioned cycle, hence this dissertation is structured accordingly. After this introductory chapter, in *Chapter 2* we present a review of the literature relevant to this project. The review of the literature may be seen as part of the *understand stage*, as the goal was to get an overview of the current state-of-the-art of the research on eBooks for children and on the design and evaluation approaches commonly employed with children. Also *Chapter 3* can be included in the *understand stage* as it extends the previous chapter by reviewing the most important works on reading motivation and leisure reading. The chapter then delineates a theoretical framework that would help the reader to better understand the concept of reading engagement and that provided us with a basis for an empirical analysis of the reading experience with eBooks. The *study stage* of this project is reported in *Chapter 4* where we describe how we explored existing reading practices of children to get a first insight on their experience with books. This stage consisted in two distinct working phases – the first consisting in observations conducted in a controlled environment, while the second was conducted in a more natural context – and was specifically aimed at gathering more information on the population of users and the context of

use, while at the same time studying the role of digital technologies in children's lives. *Chapter 5* includes the two different *stages of design and evaluation* since the design method we used implies that the two stages are run in parallel for the most part of their length. This chapter describes the work we conducted to design an eBook for children and how we translated the design ideas into a final prototype. It also contains a shortlist of design recommendations based on the ideas implemented in the prototype we built. The final *evaluation stage* is illustrated in *Chapter 6*. In this stage we describe the approach we used to evaluate the eBook prototype with children and we present and discuss the findings that emerged from the evaluation. In *Chapter 7* we draw our final conclusions and summarize the main contributions of our work. We also outline some avenues for future research that might extend the work we have done in this research project.

These chapters are complemented with three final appendices. *Appendix A* contains the source code of the Experience Sampling application we developed for the evaluation stage; in *Appendix B* we report the data we collected with the application; while in *Appendix C* we present the output of the statistical tests we performed on the collected data.

1.8 Academic publications

The work conducted within this research project has resulted in a number of publications that have been presented at various academic conferences. These publications formed a basis for the various chapters of this dissertation. Below is a list of the papers that have been published prior to the submission of this manuscript:

- Colombo, L., Landoni, M., and Rubegni, E. Understanding reading experience to inform the design of ebooks for children. *Proceedings of the 11th International Conference on Interaction Design and Children - IDC '12*, ACM Press (2012), 272–275.
- Colombo, L., Landoni, M., and Rubegni, E. Design Guidelines for More Engaging Electronic Books: Insights from a Cooperative Inquiry Study. *Proceedings of the 2014 conference on Interaction design and children - IDC '14*, ACM Press (2014), 281–284.
- Colombo, L. and Landoni, M. Towards an engaging e-reading experience. *Proceedings of the 4th ACM workshop on Online books,*

complementary social media and crowdsourcing - BooksOnline '11, ACM Press (2011), 61–65.

- Colombo, L. and Landoni, M. Low-tech and high-tech prototyping for eBook co-design with children. *Proceedings of the 12th International Conference on Interaction Design and Children - IDC '13*, ACM Press (2013), 289–292.
- Colombo, L. and Landoni, M. A Diary Study of Children's User Experience with EBooks Using Flow Theory as Framework. *Proceedings of the 2014 conference on Interaction design and children - IDC '14*, ACM Press (2014), 135–144.
- Colombo, L. and Scipioni, M.P. Children reading ebooks on tablets: a Study of The Context of Use. *Proceedings of the 8th Nordic Conference on Human-Computer Interaction Fun, Fast, Foundational - NordiCHI '14*, ACM Press (2014), 975–978.
- Colombo, L. Designing Highly Engaging eBook Experiences for Kids. *Research and Advanced Technology for Digital Libraries - TPDL 2011 Proceedings*, Springer (2011), 531–534.
- Colombo, L. Evaluating children's eReading experience through interactive and user-friendly experience sampling. *CHI 2012 workshop on "Theories, methods and case studies of longitudinal HCI research,"* (2012).
- Colombo, L. An approach to the evaluation of eBooks from a User Experience perspective. *First international worskshop on "Interactive e-Books for Children" - IDC'13*, (2013).
- Colombo, L. Serious Games or Playful Books? How Interactive eBooks can Better Support Leisure Reading. *Second international worskshop on "Interactive e-Books for Children" - IDC'14*, (2014).
- Rubegni, E., Colombo, L., and Landoni, M. Design recommendations for the development of a Digital Storytelling mobile application. *Proceedings of the 27th International BCS Human Computer Interaction Conference (HCI 2013)*, (2013).

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Chapter 2

Review of the Literature

Designing and evaluating eBooks for children – and digital-technology for people in general – requires investigating different research areas, reflecting the multidisciplinary nature of the Human-Computer Interaction (HCI) research field. For this project in the light of the research questions we exposed in the previous chapter, the review of the literature serves a threefold purpose:

1. Looking at the current state-of-the-art of the research on eBooks for children to discover which are the main trends and which areas need to be explored further;
2. Getting an overview of the most popular Participatory Design approaches in Children-Computer Interaction (CCI) research to understand which one is the most appropriate for the purpose of this study;
3. Reviewing the various evaluation methods used in CCI in order to choose one that is suitable for the evaluation of children's UX with eBooks;

Accordingly this chapter is divided into three main sections, one for each of the above-mentioned points.

2.1 Research on EBooks for Children

2.1.1 Early Years

Back in time, one of the first publications dealing with eBooks and children was Alan Kay's *A Personal Computer for Children of All Ages* [27] that we already mentioned in the introduction of this dissertation. Published in 1972,

this paper can be considered as a seminal work in the field of eBook research and Children-Computer Interaction (CCI) as well. In fact the paper envisioned a future scenario where children would have used the *Dynabook*, a portable computer conceptually similar to the eBook readers and tablet computers of today. Kay's underlying idea of the Dynabook was (as the name itself may suggest) that of a dynamic book: a medium similar to a book, but which is interactive and can be manipulated by the reader. It would support *cognitive scaffolding* [52] in the same way books and print media do, but at the same time it would take advantage from the opportunities for exploration and expression technology provides. The Dynabook was never built mainly because it was too far ahead of the technology available in the 70s, but Kay's visionary idea continued to inspire researchers in the years to come. Needless to say that it inspired us as well: our idea of engaging eBook is not much different from that of an "*active medium"* that *"can convey some of the excitement of thought and creation*" [27].

Few years after Kay's seminal paper, Anne Goldberg – one of Kay's colleagues at Xerox PARC – studied how the Dynabook could have been used with children for educational purposes [17]. This study was the first but not the last to investigate children's eBooks and eReading from an educational standpoint as this perspective represented the main trend in the research on children's eBooks in the years to come.

Educational Aspect of EReading

Following the appearance of *CD-ROM storybooks* – interactive and animated multimedia children's books distributed on CD-ROM – in 1992, many researchers investigated the effect of eBooks on children's reading comprehension and attitudes. March [32] provides a comprehensive review of the studies on the topic published until 1997. According to March, existing findings *"demonstrate a pattern of improvement or neutrality to readers of CD-ROM books in the areas of comprehension and vocabulary building"* [32]. In other words, research on the effects of eBooks on reading comprehension is mixed: some studies showed that eBooks have a positive effect on reading comprehension while other studies did not show statistically significant differences in comparison to printed books. Research is mixed also for what concerns reading attitudes, but in this case most of the studies indicated a positive effect of eBooks as, overall, children *"reacted favorably to and appeared to enjoy reading computer-mediated texts"* [32].

Researchers continued to focus on the educational aspect of eReading also in the decade from 1997 to 2007 as showed by Zucker et al.'s [56] synthesis of the research. The authors did a meta-analysis of seven experimental studies and a systematic narrative review of twenty-three non-experimental studies (which included eleven quasi-experimental studies, nine observational studies and three content analyses/surveys) including all the papers published in those years and that involved eBooks and children. Their meta-analysis indicated that *"when eBooks are used with students in pre-K through grade five, the practical effects of this technology are likely to be moderate to small for comprehension outcomes"* [56] and this result is in line with March's findings we have seen before. The authors also pointed out the need for high-quality research on the efficacy of eBooks. They stressed that methodological quality of the studies examined varied since researchers created many of their own measures – rather than using standardized measures. The review ends with some possible areas for future research, among which:

- research on the long-term effects of eBook technologies;
- research on which features available to children in eBooks can facilitate or hinder their comprehension;
- research involving upper elementary pupils;

What seems to emerge from the literature is that technology may not provide evident advantages for children in terms of reading comprehension. It is worth to notice that both reviews we examined refer to papers published prior to 2007, when eBook readers and tablet computers were far from being mass-market products and we should take this into account before any speculation.

2.1.2 EBooks Raise to Popularity

By sheer coincidence, 2007 is the year when the first models of eBook readers (e.g. Amazon Kindle®) appeared on the consumer market and started their raise to popularity. This new devices allowed people to overcome the various constraints and limitations they had to face until then, when everyone who wanted to read digital texts had to sit in front of a computer screen. Besides that, in those same years the HCI research field was in a phase of transition: from the so-called *second wave* to the *third wave* of HCI research. Roto & Lund give us a good description of these three "waves":

> *"The first HCI wave investigated human capabilities in computer use, focusing on cognitive psychology and ergonomics. The user was seen as a passive, unmotivated individual trying to efficiently use – or even serve – the computer. The second wave brought in the idea of the user as an active individual that controls the system, and the focus shifted to ease of use and user-friendliness. The third wave is not only focusing on fluent human-computer interaction, but investigates the role of – ubiquitous – technology in people's lives. It is not only about getting a task done, but 'emotions and experiences are keywords in the third wave'"* [48].

New Perspectives in Research

This series of events led researchers interested in eReading to consider eBooks also from a new perspective, different from the educational one which, as we have seen, was profusely investigated in the past. Researches started to focus not only on *utilitarian* (e.g. text comprehension, emergent literacy, etc.) but also on *non-utilitarian* aspects of eReading (e.g. pleasure, fun, engagement, immersion, etc.). Here below we report – following a chronological order – the main publications falling under this new perspective.

One of the first studies of this kind is the one by Grimshaw et al. [18] where the authors looked for potential differences in children's enjoyment (and comprehension) of storybooks depending on the medium of presentation. In their experiment children aged 7 to 15 had to read an extract from *The Little Prince* in different versions: electronic, electronic with audio narration and a printed version. The experiment took place in a school and enjoyment was measured through two closed-ended questions asking each child how much they enjoyed reading the extract (a lot, a little, not at all) and whether they desired to read the whole book (yes, no). According to the authors:

> *"There were no significant differences in the children's enjoyment of the extracts when they read electronic versions compared to when they read printed versions.*
> *The enjoyment ratings were higher for the children who had received the narration of The Little Prince, but the effect was not significant."* [18].

Despite the lack of significant results the authors indicated that the provision of narration, accompanied by animated pictures and sound effects that relate directly to the storyline may benefit children's reading of electronic storybooks suggesting also that *"electronic books that incorporate these features have the capacity to increase children's comprehension and enjoyment of storybooks"* [18].

Moody et al. [40] examined engagement (and communicative initiations) of 25 preschool-aged children while reading storybooks in varying media. Their goal was to understand the way electronic storybooks may affect young children's shared reading experiences. They described engagement as interplay between persistence, enthusiasm, and compliance [40]. Persistence involved behaviors such as pointing, page turning, commenting, and answering questions; enthusiasm included similar indicators plus smiling and laughing; while compliance included timely responding, staying seated, and following directions. Following the observation of children and parents reading together, they found that children displayed higher levels of persistence (and therefore engagement) during the adult-led electronic storybook reading compared to the adult-led traditional storybook reading [40]. However they did not come forward in support of eBooks since – as the authors themselves stated – the influence they have on children's engagement is only "relative" and the advantages they provide are not remarkable [40].

Eye-Tracking

Another line of research has pursued more fine-grained physiological behaviors indicative of engagement. Al-Wabil et al. [1] for instance conducted an eye-tracking experiment with eight participants to investigate how children allocate visual attention to dynamic content in digital books. The so-obtained data was complemented with emotional ranking surveys, performance metrics, and retrospective probing. The authors claim that:

> *"Patterns of eye movements, examined together with facial expressions of children during their interaction with digital books, effectively conveyed information pertaining to child user experiences. Surveys that use sorting methods and visual rankings were shown to elicit accurate measures of enjoyment and engagement." [1]*

The authors did provide the data obtained from the eye-tracking study, yet there is no mention of the approach they followed to analyze facial

expressions or of the questions asked in the emotional ranking survey. In the light of this it is hard to find a support to their claims in the paper. There are indeed some limitations when using eye-tracking to make sense of reading. Marshall ([35], page 101) warns about the difficulties of mapping low-level eye-tracking data onto higher-level cognitive processes and on the constraints imposed by a tracking apparatus. Besides, eye-tracking is but one window onto reading; while it provides some important data it has not shed much light on how people read in the wild but rather it has been used to validate phenomena identified through other data sources ([35], page 101). Marshall eventually suggests triangulating multiple methods in order to achieve a better understanding of how people read.

The use of multiple methods is at the base of Maynard's research on the impact of eBooks on children's reading habits [37]. The author employed a three-stage method consisting in a diary study preceded and followed by interviews of the participants. Despite it was a pilot study with a small number participants involved, Maynard attempted to draw some conclusions evidencing that *"eBook readers might be beneficial for reluctant readers"* [37] but she did not discuss in detail the impact eBooks had on children and on their reading experience.

2.1.3 Recent Years

The effects of electronic books on children's reading experience were investigated more deeply by Jones and Brown [24] who compared printed books versus electronic books on two main indicators: comprehension and enjoyment. The comprehension test aimed at assessing children's ability to *"a) preview the text, b) activate prior knowledge, c) identify main ideas, d) sequence, e) make predictions, f) make inferences, and g) draw conclusions"* [24]; while the enjoyment survey was designed to measure *"a) the students' level of enjoyment with each selection, b) the ease with which they read, c) their self assessment of comprehension, d) their motivation to read more of each selection, e) their desire to read other comparable books, f) the likelihood of reading the book outside of school, g) the recommendation they would give to a friend about the selection, and h) their satisfaction with the selection […] their preference for traditional print books or e-books"* [24]. After a statistical analysis of the data obtained from both the comprehension tests and the enjoyment survey, the authors concluded that the format in which children read the material is not an important variable for their study as the book

format did not significantly affected comprehension, enjoyment, or engagement [24].

This is probably the first study that systematically investigated children's engagement with eBooks, however some considerations have to be made. First, it is not very clear how engagement was assessed: the authors did not assess it directly and it appears that they operationalized it as a combination of motivation for independent reading and story comprehension. Then the study was conducted in the context of a school and children had to respect the experimental protocol established by the researchers, therefore were not free to read at a time and place that suited them. The problem with this approach is that school is not the typical environment where children read for pleasure and this may influence their reading behavior (e.g. they might be conditioned by the presence of their teachers).

EBooks and Engagement

Also Miranda et al. [38] conducted a study in a school to investigate young students' engagement with eBooks. Through a variety of methods which included surveys as well as qualitative observations and interviews, the researchers tried to understand whether reading books electronically would increase reluctant adolescent readers' engagement with text, and if this in turn would have pay-offs in students' further motivation to read and value of reading. Notwithstanding the limited scope of the study (children could use eReaders for 15-25 minutes during the sustained silent reading time of their class period), the authors indicated that *"reluctant readers demonstrated motivation, engagement and expressed high levels of satisfaction"* [38] with electronic reading.

A better conceptualization of reading engagement is provided by Roskos et al. [47] who describe it as a concept that *"involves a combination of attention, interest and enjoyment where children look, see, and listen with apparent pleasure to storybooks read aloud to them. […] Engagement, in sum, involves self-direction, interaction, emotion, choice and a sense of competence."* [47]. Their study aimed at better understanding children's engagement with eBooks at preschool and at how the format (organization and arrangement) of an eBook may influence children's engagement. In a first phase they identified a typology for observing engagement with eBooks which includes three main categories: control (i.e. the power to take meaningful action and to see the results of decisions and choices), multi-sensory behavior (i.e. using visual, auditory and haptic-kinesthetic senses),

communication (i.e. using verbal and nonverbal behaviors to respond to language and express comprehension). In a second phase they applied the typology as an analytic framework to describe children's engagement with eBooks during teacher-led shared reading and independent eBook reading with a handheld device (i.e. iPad®). They found that teacher-led shared reading at the touch screen appears to afford less control for children than independent eBook reading. This, in turn, influences multisensory behaviors with an increase in looking-touching-listening and a decrease in moving-gesturing [47]. Among the studies we reviewed, the one of Roskos et al. is the most thorough from a methodological point of view, yet a clear indication of the influence of eBooks on reading engagement fails to emerge. This is probably due to how the study has been conducted, because rather than investigating how the format of an eBook influences engagement it ended up in a comparison between teacher-led and independent eBook reading. In addition we stress that – as we found in the studies we reviewed previously – once again the study took place in a formal learning environment and not in a natural leisure reading environment.

In the last year (2013) there was a rise of interest around children's eBooks. Following this, the first studies investigating leisure eReading in a natural context made their appearance in the literature. Massimi et al. [36] for instance, contributed with a diary study – preceded and followed by qualitative interviews – where they explored children's partnered reading (or co-reading) practices while reading (an eBook on the iPad®) for pleasure at home. They explored various thematics including reasons for reading for pleasure as well as social and pragmatic aspects of eReading, and drawing on their findings they proposed a shortlist of implications for the design of eBooks. The authors touched on some of the opportunities for eReaders for making it easier to schedule, maintain, and enjoy partnered reading. Being one of the first of this kind, this study is very interesting and (as we will see later in this dissertation) shares some methodological and procedural aspects with the evaluation study we have conducted. However, Schreurs [50] have raised some concern on the topic investigated (co-reading) highlighting the fact that *"co-reading inextricably involves the preferences of adults and their rooted sensibilities about reading […] residual print culture impacts adults' perceptions of eReading and eBooks and therefore impacts children's perceptions and access"* [50].

Schreurs' work also provides an interesting overview of the state-of-the-art of research on eBooks for children and confirms the indications that emerge from our literature review. Schreurs evidences how relevant research

on eBooks for children is limited also due, in part, to the fact that it is a relatively new phenomenon [50]. In addition the research that does exist focuses largely on literacy and education while little attention has been paid to investigating the eReading experience. Therefore *"more research is needed, especially research that focuses on children reading eBooks for pleasure, and on the opinions and preferences of children."* [50].

Also, as noted by Kucirkova [29]:

> *"Currently, there is inconclusive evidence about how the affordances of interactive eBooks support children's learning, with studies mostly limited to comparison studies with non-digital books and observational studies of children's immediate engagement. In both lines of research, the content of the stories, the overall context of interaction and the background of the interactants are neglected."* [29]

As it emerges from our literature review, the body of research on children's engagement with eBooks is rather thin [47] and eReading for pleasure more generally, remain underexplored in the HCI literature [36] as existing research is mainly focused on the educational implications of eReading. But also in this area the studies are still few and the results are somewhat conflicting [51]. In this regard Salmon [49] provides an up-to-date review of the research on the matter published between 2000 and 2013[1] – we refer the reader to the original article for more details on the studies reviewed therein.

In conclusion, to use a catch phrase: *"more research on the topic is needed"*; and this is one of the main reasons as to why we carried out the study which is described in the following chapters.

2.2 Collaborative Design in CCI Research

Involving children in the various stages of the design process has become a common practice in CCI research, and their involvement has grown over the years, so much that they are now often regarded as *design partners* [9]. Children can be involved in the technology design process in a variety of ways [12], and CCI researchers generally agree on the benefits of co-

[1] Which partially overlaps with Zucker et al.'s [56] synthesis of the research we have discussed before.

designing with children [13,20,42]. Few if any researchers would dispute the value of including children in at least some aspects of the design of children's technologies; the dispute lies in the methods for accomplishing this [42].

In this section we review the various methods and techniques of involving children in the technology design process. We present a summary of what others have previously published in this area following the same general outline of Fails et al. [13]. Before doing so we briefly describe the concepts of participatory design and collaborative design.

2.2.1 Participatory Design and Collaborative Design

Participatory design (PD) is an overarching theory that originated in Scandinavian countries and that – as its name may suggest – advocates the involvement of end-users in the technology design process. It began as a workplace movement under the premise that workers themselves are the best qualified to determine how to improve their practices at work [4]. According to Carmel et al. [4], two themes govern practical implementation of PD principles: *mutual reciprocal learning* and *design by doing*. With the first theme users and designers teach each other about work practices and technical possibilities through joint experiences, while with the second theme users participate through interactive experimentation, modeling and testing support, hands-on design, and learning by doing [4]. While PD had very specific beginnings, the techniques of PD have been built upon and expanded in other methods employed in interaction design research, including those intended to involve children in the design process. In fact according to Nesset and Large [42] *"the principles of participatory design are the most suitable for design projects involving children"*. Currently PD encompasses a large field of research and is the basis for many of the co-design methods employed for adults and children such as bonded design and cooperative inquiry[2] (we will discuss both methods in the following section). [13].

Collaborative Design – or co-design – is a subset of PD in which expert designers work with the target audience to solve a problem [54]. Even though PD is often used as an umbrella term to include any design activity with end-user involvement, peculiar of co-design is that the end-user has an active role in the design process. This subtle distinction is necessary because term co-

[2] Along with some aspects of *contextual design*, design by doing is the form of PD that constitutes the basis of *cooperative inquiry* [42].

design implies that the user becomes actively involved in the design process instead of merely testing a system or providing feedback at the end of the design process [54]

2.2.2 Co-design Methods

Following Walsh et al. we define a design method as *"a collection of techniques used in conjunction with a larger design philosophy"* [54]. Accordingly, a design technique is defined as *"a creative endeavor that is meant to communicate design ideas and system requirements to a larger group"* [54].

Several co-design methods can be identified in the literature. Among those that have been adopted and/or adapted for children we have: Bluebells, Bonded design, Cooperative Inquiry and Children as Software Designers. Actually other methods exist but for the purpose of this study we limit our review to the most popular ones – for a more comprehensive review the reader could refer to Walsh et al. [54] and Fails et al. [13].

Design Method	Ages
Bluebells Sequential process where adults meet, then observe children, then meet again. Includes activities broken into three design phases: before, during, and after play	7-9
Bonded Design Children participate for a short-term but intensive time (e.g., twice a week for six weeks) participating in activities and utilizing techniques such as those that used by informants or design partners	11-12
Cooperative Inquiry Children and adults work together as partners throughout the design process in a collaborative and elaborative manner; cooperative inquiry teams are characterized by having a long-term relationship that spans across projects	7-11
Children as Software Designers Children design software using tools designed for them	8-12

Table 2.1) Common CCI design methods and the ages of children who have participated in these methods as found in the literature (adapted from Fails et al. [13])

Bluebells

Bluebells is a design method that takes its name from a popular British playground rhyme and that was ideated by Kelly et al. [28] The bluebells process has three stages: before, during, and after play.

The first stage – before play – is where the adults identifies the key requirements for the product in relation to the constraints of the project [28]. The second stage – during play – is the one where children get actually

involved in the design [28]. There are four activities that can be carried out in this phase to collect design ideas: I-Spy, Hide and Seek, Tig and Blind Man's Bluff – again, each named after a children's playground game [28]. Each activity has a different purpose that directly relates to an aspect of the system that is being designed: the I-Spy game's purpose is to gather contextual information; the Hide and Seek game, the content for the application or product; Tig, the navigation and control mechanisms; and Blind Man's Bluff to get the look and feel of the interface – each of these activities can be thought of as a technique within the overall Bluebells method [13]. In the third stage – after play – the design team then collates and examines the outputs from the activity sessions and incorporates them into design documentation, using them to produce early prototypes [28]. In this stage adults identify underlying interaction concepts and interface structures that they will then implement in the final design [13].

Bluebells have been proven to work with children aged 7 to 9 years old [13] and has been employed to design a range of interactive product to be used by children during museum visits [28].

Bonded Design

Similarly to cooperative inquiry (discussed later in this section), *Bonded Design* [30] emphasizes on an intergenerational partnership between adults and children working towards a common goal [30]. But at the same time the proponents of the method question the true ability of children and adults to work as equal partners, in other words they question whether equality can exist within an intergenerational team, and this aspect is in line with the informant design model [30]. Bonded design, essentially, is situated between these other two design models, sharing the former's belief in the ability of children to work as partners in all aspects of the design process, but the latter's reservations about the extent to which full and equal cooperation can be established across the generational divide [30].

According to Fails et al. [13] this method can be a good option for a design team that would like to do in-depth co-design with children, but lacks the resources (e.g time, space, money, etc.) to sustain an ongoing child design team. As a drawback it might be more difficult to establish a firm relationship with children compared to an ongoing co-design team where children had more time to truly become designers and partners.

In Bonded Design children participate to the design activity for a short period of time – usually few weeks – during which they work intensively on a

single project. The method has been implemented primarily with children aged 11 or 12, typically with children all of the same age [13] – or with small variations – and with teams composed of about a dozen elements. Bonded design has been primarily used to develop web portals' interfaces but the proponents of the method claim that it can also be applied in other contexts with other user groups [30].

Cooperative Inquiry

Developed by Druin et al. [11,12] *Cooperative Inquiry (CI)* has its roots both in the *contextual design* theory and in the *design by doing* interpretation of *participatory design* theory [42]. CI is essentially a method of design partnering created to design technology with and for children [21]. The basic assumption of this method is that adults and children work together throughout the entire design process to elicit new ideas and create new technological artifacts. CI is an approach to research that entails three crucial aspects: a multidisciplinary partnership with children; field research that emphasizes understanding context, activities, and artifacts; iterative low-tech and high-tech prototyping [11].

CI incorporates techniques from several different participative methodologies [42]. The process of cooperative inquiry begins with techniques borrowed from contextual inquiry such as brainstorming and interviewing in order to understand what children do with existing technology. Unlike contextual inquiry, with its minimal interaction between researcher and user, cooperative inquiry involves more than observation. Cooperative inquiry also uses techniques from participatory design. In participatory design, the researchers listen to what the users have to say by direct collaboration in the development of low-tech prototypes [12,42]. Low-tech prototypes are developed by both children and researchers (working together in an *intergenerational* design team) to support the brainstorming and idea generation stage of the design process [12,42]. Another technique that Druin has included into cooperative inquiry is ''technology immersion,'' which involves observing what the children do when exposed to unlimited access to extraordinary amounts of technology. Used with the observational techniques of contextual inquiry and low-tech prototyping of participatory design, technology immersion is effective to identify roles and patterns that are not obvious in short contextual inquiry sessions [12,42].

The goal is to give children a voice in design process, therefore an important feature of CI is its intergenerational nature in equally valuing the

voice of both children and adults in the design process. Children and adults work as partners: *"The adults do not teach or guide children in the traditional sense; rather they are equal stakeholders in the process. Adults are experts in areas such as computer science and visual design, while children are experts in knowing what it is to be a child today"* [13]. In summary CI offers a chance for in-depth involvement of children over the long-term of a technology design process, but on the other hand this requires a considerable investment of resources in terms of time, money, space, and people [13]. CI has been primarily implemented with children aged 7 to 11 [13] and researchers utilized it to develop a wide variety of technology, from digital libraries [10] to learning technologies [55].

Children as Software Designers

Another way children can participate in the design of new technology – apart from their involvement as informants (bonded design) or design partners (cooperative inquiry) – is that children can be software designers and developers without significant interaction with adults during the design process [13]. In the *"Children as Software Designers"* method children are fully in charge of the software development as they work either alone or with their peers without adults' intervention, if not just for teaching children the technological skills they need to carry out the process [25]. Children would eventually emulate some but not all the aspects of professional software design practices allowing researchers to understand more about children's conceptions of software, their expectations and their experiences in software design. The *"children as software designers"* method has been first introduced by Kafai [25] and has been employed mainly with children aged 8 to 12 [13].

2.2.3 Co-design Techniques

Within the various methods described in the previous section, several techniques can be used. As mentioned earlier, a technique is an activity that a design team participates in while creating a technology. Techniques are not associated with one specific method as they can be used within diverse methods. Walsh et al. [54] examined the HCI literature for design techniques that researchers have used in participatory design with children. Here we provide a list of the main techniques that have been used within the

Cooperative Inquiry method. For more details on these and other co-design techniques the reader may refer to the work of Fails et al. [13].

Bags of Stuff

This is probably the earliest and most common prototyping techniques for the creation of low-tech prototypes used by an intergenerational design team [11]. Within Cooperative Inquiry, Bags of Stuff has proven useful as a brainstorming design technique: it has helped to generate many ideas for new technology and it has also proven useful as an icebreaking technique when a new partnership or team is established [13].
When using the Bags of Stuff technique, the design group is generally split into smaller groups (comprised of 2 to 4 children and 1 to 3 adults typically). Each group then receives a bag containing low-tech art supplies such as paper, markers, glue, scissors, etc. (the material included in each bag can be varied depending on individual project circumstances). Ideally, each team develops one prototype, although depending on the ideas generated, a team may have more than one prototype. At the end of the design session, each team takes turns standing in front of the larger group and describing their ideas [54].

With this technique the adult role not only includes building, and facilitating a collaborative and elaborative experience, but should also include observing what occurs during the low-tech prototyping process. While the artifact itself is important, the building of the model and the discussion and elaboration that occurs around the prototype is equally relevant [13].

Storyboarding

Storyboarding is another commonly used technique where the “story” of a system design is drawn on paper to establish a timeline as well as the aesthetics of the system. When working with children variations of traditional storyboarding can/should be used. Moraveji et al. [41] introduced *Comicboarding*, a storyboarding variation intended for children aged 6 to 13 who need support in brainstorming. In Comicboarding, a child and an adult work together to fill in a partially completed comic using paper and pencils. Children are given the option of narrating their ideas to have the adult illustrate for them. Researchers found that by using a familiar construct, the comic, along with the scaffold of having a skilled artist offers to draw ideas

dictated by the children, the children gave more ideas than they did with a non-scaffolded traditional storyboard technique [13].

Sticky Notes

The *sticky notes critiquing* technique is often used in Cooperative Inquiry and requires children and adults to critique an existing technology or prototype [11]. The goal of the technique is to evaluate prototypes and provide feedback and direction for future improvements of a given technology.

This technique is especially useful towards the end of the design process as a way to identify likes, dislikes, and design ideas around a nearly complete prototype [13]. In this technique, children and adults in pairs evaluate the technology by first interacting with it and then annotation likes, dislikes, or design ideas on the sticky notes (one idea per sticky note). The sticky notes then are placed on a whiteboard where are organized into groupings of similar themes [54]. This technique involves more than simple evaluation, as the likes, dislikes, and design ideas are used to inform the design requirements in the iterations that will eventually follow [54]. The advantage of this technique is that it requires a few supplies (i.e. sticky notes and pens/pencils) and thanks to its flexibility can be applied in a variety of contexts.

While the above described technique is how sticky notes are employed with children aged 7 to 11, sticky notes have been used by designers in many ways and the technique can be adapted for younger as well as older children [13].

Fictional Inquiry

Fictional Inquiry is a set of brainstorming techniques that have been specifically developed with children in mind. All these techniques require children to participate in a make-believe scenario through which a narrative is set up to gather user requirements. The two main Fictional Inquiry techniques are *KidReporter* and *Mission to Mars*.

KidReporter is a technique developed by Bekker et al. [3] where children can use videocameras and notepads to take photo, videos and notes during the evaluation of a system. This allows children to contribute with their opinion to a design problem through a choice of activities that finally result in a newspaper reporting on the children's idea about a topic [3]. In its original conception the technique combines four activities (taking photos,

writing captions, holding interviews, writing articles and filling in questionnaires) and can be used effectively with children aged 9 to 10.

The Mission from Mars technique [8] provides a way for children to express their ideas on a specific topic by communicating to a "Martian" – i.e. an adult researcher in another room broadcasting a message to the rest of the team and who represents someone that does not understand life on Earth. Adult participants present the narrative, divide children into groups for the Martian broadcast, and help the children to communicate with the Martian [54]. During the first session, a design problem should be established, then for few sessions the children work together to address the problem and create design solutions, and at the end in a final session small groups of children present their ideas to the "Martian". This technique was originally conducted with children aged 10 to 11 [13].

Mixing Ideas

Mixing Ideas is a technique originally created by Guha et al. [19] which aims at facilitating younger children working collaboratively with others as partners in the design process. In the first stage of this technique, the leader presents the team with the problem to be solved, then each individual team member sketches ideas on paper. Adults team members then review the sketches, make a copy of them, and group those that have similar ideas and are thus likely to be easily combined. In a second stage, the team members are assigned to pairs, who then "mix" previously emerged ideas together: children may use tape, scissors, and new paper to either to disassemble or to combine initial ideas or to create a new drawing of the mixed idea. The goal of this stage is to further refine and elaborate the design ideas emerged in the previous stages or to create new ones. This second stage can be iterated for as many times as needed. Eventually, and depending on the goal of the design team, there might be an additional third stage where all the team members gather in a single group, disassemble the ideas previously originated, and reassemble them together in an ultimate larger "big" design idea. [54].

The Mixing Ideas technique grew out of a need to combine the ideas of many individuals into one idea as children are relatively good at coming up with individual ideas yet are often reticent to combine their ideas with others' [13]. This technique was created for use with 4 to 6 years old children, but it can also be beneficial when starting a new design team with older children as children can see how their individual ideas combine with

other's ideas allowing them to trace the evolution of the large idea and their voice in it, thus fostering their sense of individual ownership in the collaboratively created design [13].

Layered Elaboration

Layered elaboration is a paper-based prototyping technique in which designers use transparent layers to enable iterative design without "ruining" the original idea [53]. In this technique, children and adults work in small groups sketching their ideas on how to address a stated problem. After this first phase the groups meet to describe what they did to the other groups. When all of the groups have presented, a transparent sheet is added on the top of each sketch and then passed to a different group. By doing so the groups are allowed to add to the design by drawing on the transparency without [54]. This process is repeated as needed and subsequent elaborations are stacked on top of each other: his enables to understand the evolution of the whole design during the design process and permits to undo modifications if needed.

This technique was specifically developed for use in the Cooperative Inquiry method with children aged 7 to 11 and it finds its best application when designing screen-based media, when combining the ideas of distinct groups, and when resources are limited [13].

2.3 User Experience Evaluation in CCI Research

It is well known that conducting technology evaluation studies with children is challenging, for many reasons: children cannot focus on a task for very long and they can be easily distracted [2,23,34], they often try to please adults [33,34,46], and they may have difficulty expressing their likes and dislikes in words [19,22,34,42]. Therefore not all the evaluation methods that are commonly used in HCI research can be straightforwardly employed when children are involved: some of them need to be adapted while others simply cannot be employed.

There have been various attempts to distill the knowledge and experience on CCI by defining guidelines or best practices to be useful for researcher working in this domain. Perhaps the first publication of this type is the one

by Hanna et al. [22] who enumerated a set of guidelines for usability testing with children; on how to deal with, and what to expect from, children before, during and after a software usability test. More recently the members of the EU Kids Online network published a report [44] on the challenges and the best practices of conducting research on children and online technologies. Both publications well summarize the various issues of conducting research with children as they are not just "small" or "short" adults, they differ from adults both physically and cognitively. In addition to that children's cognitive abilities evolve with age. Even though Piagetian theory[3] has been subject to challenge, all developmental approaches recognize that children's cognitive capacities clearly increase with age [31]. Therefore differences between age groups exist and researchers should take that into account when deciding which evaluation method to use.

Markopoulos et al. [34] provide a comprehensive overview of the research methods used in CCI. Here we summarize the part of their book dedicated to the "Methods of evaluation". For more details the reader can refer to the original work.

2.3.1 Evaluation Methods

Recording and Logging [34]

Three main methods are employed when it comes to record user interaction with a digital system: automated logging, eye-gaze tracking and audio/video recording.

Automated logging involves recording the user's inputs to a system (e.g. keystrokes, mouse movements, time, etc.) or the system's output on the screen in a way that is completely transparent and not intrusive for the user. Despite this, users involved in such a study must be informed that they are being watched and their actions are being recorded, as avoiding to do so would raise some concerns from an ethical standpoint. A practical issue to be considered is that to capture the data the evaluator must have access to the low-level operating-system functions that receive the users' input, and sometimes this is simply not feasible – e.g. when the device runs a proprietary operating system that does not provide an application programming interface (API) to access the desired resource.

[3] See the definition of *child* in Section 1.6

A second method is *eye-gaze tracking*, namely tracking what the users are looking at from moment to moment as they carry out an activity. The data collected by an eye tracking system consists in the position and duration of the user's fixations over an interface. These information can be very useful in understanding what the user is doing, how, and why. It is usually possible to conclude that an unusually long fixation (or repeated fixations on the same object) is caused by the object being especially interesting. Or especially confusing. As a matter of fact interpretation of eye-tracking data can be tedious and mapping low-level eye-tracking data onto higher–level higher-level cognitive processes is by no means straightforward ([35], page 101). In addition, an eye-tracking study imposes some important constraints as we need to use desk-mounted or head-mounted cameras that track the infrared light reflected by the eyes. In both cases this apparatus would require some calibration and this is a complication when working with children as they often lack the patience required by this process.

Automated logging and eye-gaze tracking are but few windows onto users' interaction with a system. If we want to capture the user experience as a whole, which means considering also users' behavior and the context of use, *audio/video recording* may be a valid alternative. With current technology the setup is quite easy and inexpensive and there is no need to run the study inside a lab – a space which may intimidate some children. A small camera (or even a smartphone) is enough to record children's behavior – such as facial expressions, body language, or hand gestures – and this permits to run the study in a more informal – and less intimidating – place than a research lab. If we want to have this footage mixed with a synchronized stream of what is on the screen of a desktop computer, then we just have to use a screen-recording software and a camera that can be connected to the computer in use. The main drawback of this method concerns the privacy of the participants. A child can be easily identified by his/her face (and even by his/her voice), therefore appropriate consent is needed before recordings are made or shown and researchers should take every precaution to avoid unintentional disclosure of personal information.

Observation Methods [34]

Generally speaking *observation methods* entail the examination and subsequent description of a phenomenon. In HCI research the phenomenon studied is the use of a digital interactive system. Observations are an invaluable source of information when it comes to evaluating products for

children. Observing children interacting with a prototype or product can unveil usability issues and provide new insights to designers and researchers on how to improve the user experience. The purpose will be, eventually, to suggest recommendations for improving the product or to highlight issues that must be resolved before proceeding in the next step of the development.

Observation can be conducted either in "in the field" or in a lab. In the first case the research activity will take place in the "real world" while in the second case it will take place in a more controlled environment as that of a research laboratory. The advantage of conducting observation in the field is that the researcher can observe how a digital device is actually used in a real context of use (this aspect is especially relevant when it comes to mobile devices). The downside of this approach is that it requires a considerable amount of time and resources. If we want to observe a more structured and controlled use of a digital device, minimizing the impact of contextual factors and other variables, then conducting the observation in a lab might be a better option.

When it comes to observation, the realism of the situation observed and the validity of the findings are greatly influenced by the interaction between the observer and the participants. When product use is embedded in daily activities or social interactions between members of a group and is very much dependent on context, observers may decide to engage with participants and embed themselves in a group. This approach is often referred to as *participant observation*, a method that is closely associated with *ethnography.* Participant observation can be very useful when the goal of the evaluation is to evaluate the role of a product within daily activities or within a group, its usage patterns and, more generally, the social aspects of the product's usage; while it is less applicable for analyzing user experience at a more cognitive and sensorial level or for evaluating user performance. In this case it is better to limit interaction with the testers to the minimum necessary so there is less risk of influencing the conclusions of the evaluation. This approach is known as *naturalistic observation* (or *passive observation* if carried out in a lab). Observing children while they do "free reading" at school is an example of naturalistic observation (more on this in Chapter 4).

Observations can then be structured or unstructured. An unstructured observation starts with open questions where the observer tries to identify and record interaction aspects in a holistic way. The advantage of unstructured observations is their open-endedness. On the other hand the lack of focus can cause some problems. It can lead to a low number of

observations and low reliability of results between observers because each observer influences data collection with her own mindset, knowledge, and experience. To avoid this an observation can be structured, meaning that prior to conducting the study the researcher has to determine the focus of the observation and develop observation guides and forms.

Verbalization Methods [34]

Verbalization methods are those where participants are asked to explain verbally their thoughts and actions while they are interacting with the product under test. Verbalization techniques fall between the observation techniques discussed in the previous section and the survey techniques (that will be discussed in the next one).

Verbalizations can be elicited, or can be spontaneous, meaning that the administrator can obtain verbalization data either by explicitly instructing testers to verbalize their thoughts or, more subtly, by creating a situation in which verbalization happens more or less spontaneously. In both cases, verbalization methods need substantial re-adaptation when testing with children. For children, verbalization can be difficult for several reasons: their language skills are still not fully developed, extra cognitive workload is put on the participants, many children are shy toward adults, children may have an implicit understanding that there is a right and a wrong answer and they may tend to act as if their performance is what is being tested. As a general rule of thumb, to tackle these issues the administrator should consciously try to create a comfortable and relaxed atmosphere so it is easy for the child to talk. For the reasons we just mentioned, in the past researcher have been skeptical about employing verbalization methods with children, but recent studies have shown that children as young as age 7 are also capable of thinking aloud – provided that a less demanding and dialogical form of think-aloud is adopted. In general, for children over age 9 it seems that all techniques will work to some extent, while getting verbal data from younger children is more difficult.

Among the various verbalization methods, *Think-Aloud* – a method which originates from cognitive science – has been established as a standard practice in usability testing of products for adults: what people say while testing a product, may uncover usability problems and provide some new insight into how the tested product is perceived. Think-aloud has been used also with children, not only for usability testing but in the educational research field as well. The original form of think-aloud can be characterized

as concurrent: the verbalization is obtained while the tester is interacting with the product. But the verbalization can also be done retrospectively (retrospective think-aloud), with participants watching a recording of themselves interacting with the products and commenting on their actions. This approach has the advantage of reducing the cognitive load while performing the test but at the same time may suffer from recall biases – especially relevant with younger children and longer sessions.

The use of verbalization method should not be aimed at capturing every step of the human-computer interaction process, but rather it should be intended as a way to understand children's subjective experiences while the interaction unfolds. With the exception of retrospective think-aloud, one clear advantage of verbalization is that it allows obtaining commentary on preferences of the tester while the interaction is taking place, helping to elicit thoughts that would otherwise remain unobserved. Another important advantage is that opinions and expressions of emotion are obtained in the context of interaction and can be related to very specific aspects of the interactive product.

One disadvantage of verbalization techniques is that the tester might be cognitively overloaded, as he is required to perform two different tasks at the same time. In addition the presence of the administrator or other researchers may influence the course of the interaction and may mean that the interaction that unfolds is not representative of actual use.

Simulation Methods [34]

One well-used method for evaluating novel technology is simulation. Simulation is where a user engages with a prototype of the final product. The main benefit of using simulations is that certain features of products can be evaluated before a fully functional version is available. In Human–Computer Interaction, this kind of evaluation is well known under the name of *"Wizard of Oz"*. A Wizard of Oz evaluation is one in which some or all of the interactivity that would normally be implemented through hardware/software technology is imitated, or "wizarded," by a human being. During the study, the human wizard manipulates the interface without the subject being aware (to varying extents) of the existence and impact of the wizard. Typically a Wizard of Oz study has three components: a human wizard, an interface prototype, and a subject (user). What can vary from study to study is the functionality of the prototype, the amount of wizard control, the discretion and visibility of the wizard, etc.

Wizard of Oz studies is not suitable for every circumstance as there might be restrictions imposed by the system. For instance systems with analogue outputs, systems that require rapid responses and systems that are difficult to observe are all problematic. Overall, it can be said that Wizard of Oz studies are more suitable in cases where the simulated functionality falls into the category of everyday human and that functionality is relatively hard to implement in an interactive product. As a matter of fact most of the practical problems and concerns with the validity of the research in WOz setups are related to the fact that the wizard is a human being.

In recent years an increasing number of studies have used the Wizard of Oz method with children and the research literature on applications of the method with this population extends to various contexts (for a list of suggested readings see [34]).

Survey Methods [34]

The method of eliciting information by question and answer is commonly referred to as a survey method. Questionnaires, rating scales and structured interviews are all included in this category of evaluation methods. In general, questionnaires and rating scales are used for large groups and often administered at one time, whereas interviews are usually done in sequence with one respondent at a time (the person doing the survey).

In HCI research survey have been used for many purposes and with different user populations, including children. As with all the other methods, decisions on which survey method to use depend on the ages, skills and the number of the children involved.

Interviews are best suited to confident children and a small number of respondents. They have the advantage that a lot of detail can be obtained and children do not have to read and write. In addition, because the interviewer is present to clarify unclear responses or ask follow-up questions, the information gleaned can be more informative. The interviewer can also evaluate directly whether the child understands a question and can also determine the degree of comfort the child has with her answers. Interviews are often one to one – which can make the child uncomfortable – but they can also be done in pairs or with small groups of children. On the other hand, interviews take time to conduct, arise several ethical problems and can be very daunting – even for adults.

Questionnaires are less threatening than interviews and are better suited to large cohorts because they can save time. The information that is

gathered, however, is often more limited than what you can get from interviews. One advantage of questionnaires is that it is possible to have a large group of children complete them together. However children sometimes copy from one another or answer questions without really understanding them and asking for clarification – to avoid looking foolish.

When respondents are children, extreme care must be taken when designing questions and the questionnaire as they should be adapted to suit the cognitive, linguistic, and social competence of each age group [31]. First of all it is important to understand the question-and-answer process, which according to De Leeuw et al. [31] consists in four main stages:

1. Comprehending and interpreting the question being asked
2. Retrieving the relevant information from memory
3. Judging the retrieved information
4. Reporting/communicating the final response

To facilitate children's comprehension of the question the questionnaire should be well structured, should not be too long and should aim at the language level of the intended population. Ambiguous, suggestively phrased, negatively formulated or double-barreled questions should be avoided [31]. It is also important to carefully phrase the question as children tend to take things literally.

After understanding the question a child has to retrieve the relevant information from memory. The questions should be easily recognizable and should not be too complex. A general advice is to avoid retrospective questions as far as possible – especially when asking for non-standard events and details – but instead to use 'here and now' questions [31].

In the judgment phase a child has to combine all retrieved information into a preliminary answer and evaluate the answer. Children have the tendency to please the researcher – or teacher – and this, together with social desirability and the concern to say something wrong or foolish, is a factor that may influence their judgment phase. To limit these biases researchers have to make sure that the questions do not resemble test items or school questions. They should also emphasize that the survey is not a school test and that there are no "correct" or "wrong" answers. Peer norms and questions' sensitivity should also be taken into account as potential influencing factors [31].

In the final stage, the child must be able to correctly communicate his/her answer or to understand the presented response options – if any. In this last case, for adults and late adolescents five to seven response categories are

generally advised. The presented responses should be limited to four to five options for children in late middle childhood (10-12 years old) and to two or three options for younger children. Besides the number of response options, labeling is a crucial factor. Clear labels will improve the reliability of answers of while any ambiguity in labeling will negatively influence the data quality [31].

In addition to what we discussed so far, children are also prone to *satisficing* and *suggestibility*. The first occurs when *"a respondent gives more or less superficial responses that generally appear reasonable or acceptable but without going through all the steps involved in the question-and-answer process"* [46]; while the second term concerns *"the degree to which children's encoding, storage, retrieval, and reporting of events can be influenced by a range of social and psychological factors"* (Scullin and Ceci, 2001; as cited in [46]).

To help researchers in dealing with the above-mentioned issues, De Leeuw et al. [31] proposed an expert appraisal coding schedule with practical recommendations on how to design questionnaires for children and adolescents (some of which have been outlined in this chapter). Along the same lines, Read and MacFarlane [46] proposed a shortlist of guidelines on how to approach the surveying process in order to make it valuable and satisfactory for all parties involved. Their advice is to: keep the evaluation short, pilot the language, provide assistance for poor readers, limit the writing, use appropriate tools and techniques, make the procedure fun, expect the unexpected (have a backup plan), do not read too much into data, be nice and make participants to feel at ease.

Figure 2.1) The Smileyometer (from Read and MacFarlane [45])

Apart from questionnaires and structured interviews, the use of rating scales is quite popular in CCI research. Among them one of the most popular ones is the *Fun Toolkit* [46], a collection of four tools – *Funometer, Smileyometer, Fun Sorter, and Again-Again table* – developed with the above-listed guidelines in mind. The Funometer is a continuous scale – like a thermometer – on which the child draws a bar that represents the amount of fun ho/she had – the longer the bar the more was the fun. The Smileyometer

is a 5-points[4] pictorial Likert item where every option is represented by smileys; the options range from the sad smiley (awful) to the happy smiley (brilliant): by checking the appropriate face children can indicate what they think of a product. The Fun Sorter is essentially a table that children can use to rank a series of connected or competing activities or technologies by reporting them in the cells of the table – sorted from the best to the worst one. The Again-Again table is another way compare activities or technologies based on the idea that, for most children, a fun activity is one they want to repeat. This table lists some activities or instances on the left side and has three columns titled Yes, Maybe, and No. The child ticks either Yes, Maybe, or No for each activity, having in each case considered the question "Would you like to do/use it again?".

Diary Methods [34]

Almost all the methods described so far, to be used require the presence of a test administrator, a relative short duration and an environment that can be easily controlled. In some circumstances such settings can be unrepresentative of actual use. When *ecological validity* – i.e. the extent to which the setting of a research study reflects real-life settings – of the test is important, the best choice is often to deploy and test over time, in the field, and without the presence of a test administrator.

Field evaluation is particularly useful when ecological validity should be preserved and the evaluation goals concern longer-term use rather than first exposure to the tested artifact. Whereas short-term evaluations are helpful for discovering how a new product is used, many aspects of interaction can be discovered only when the tester has mastered the system's usage.

Field evaluation is also useful in those situations where it is practically difficult for an observer or test administrator to be present when the product is used. In this case *diary methods* can be employed.

A diary study can be described as a form of survey in which the participant in independently answers questions set by the evaluator over a sustained period of time. The method takes its name from the diary on which participants write down their answers. Diary methods share many of the characteristics of survey techniques, so they are well suited for discovering thoughts, feelings, and generally subjective experiences – as the user experience is. The difference is that with diaries participants report opinions

[4] According to De Leeuw et al. [31] the use of graphical response options allow to make an exception to the rules for number of response options and labeling.

and attitudes repeatedly over time, and this allows the evaluator to put together a picture of longer-term usage patterns. Compared to other methods, diaries are particularly appropriate for collecting the opinions and thoughts of testers in context, close to the time of the event or experience under investigation. Diaries help the evaluator to understand contextual factors that influence how a product is used and reduce the problems associated with recollection – e.g. recall bias – that would arise with traditional surveying of participants, especially at the end of a long period of use.

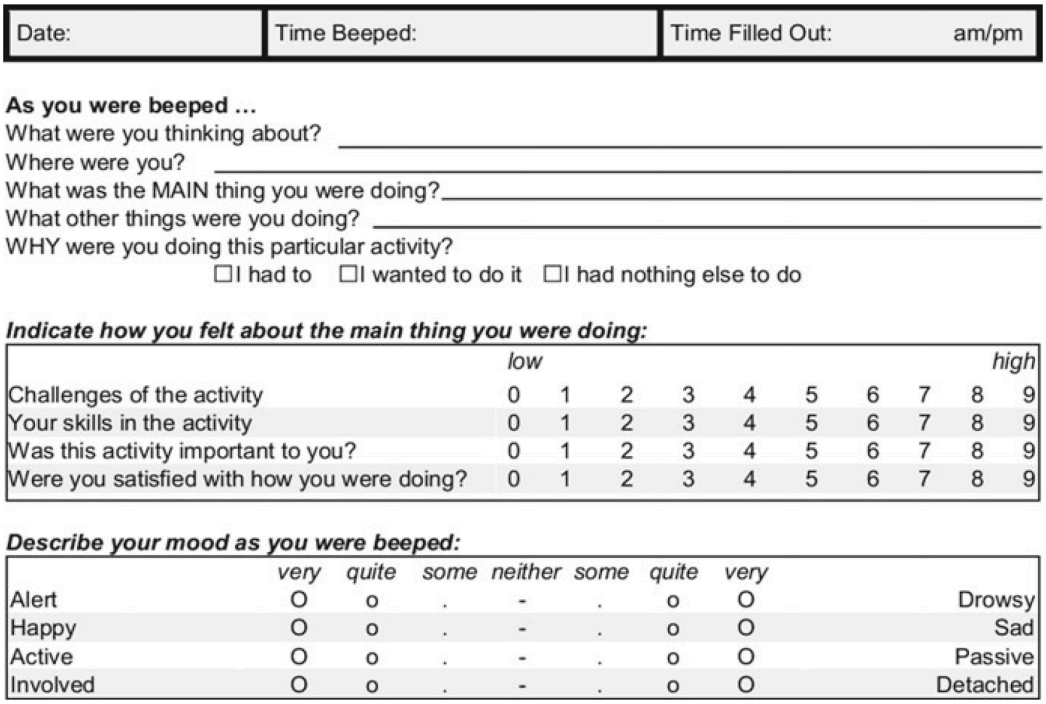
Depending on the goals of the evaluation, a diary study can take many forms. Like questionnaires, diaries can be highly structured or very open. The structure of the diary is determined partly by the sampling it is intended to support and partly by the kind of questions you choose to ask. Participants may be asked to report at regular intervals (*time-based sampling*) or to report the occurrence of specific events (*event-based sampling*). Time-based sampling can help portray patterns of use over time, while event-based sampling can help maximize the number of instances captured in the diary when the product is used sporadically.

Typically diary studies are associated with a briefing interview at the start, where informed consent can be obtained and the participants can be profiled and instructed on how to keep the diary. At the end a debriefing interview will allow the evaluator to obtain more data on the experience studied.

A variant of diary methods is the *Experience Sampling Method (ESM)*. Originally developed by Csikszentmihalyi to investigate flow in everyday life, ESM is an ecologically-valid contextualized data collection method in which participants' experience is repeatedly assessed in real-time through questionnaires ([7], page 67). Essentially, participants fill out several brief questionnaires (see Figure 2.2) every day by responding to alerts. ESM does not require participants to recall anything; instead, questionnaires ask about the participants' current activities and feelings. This reduces the cognitive biases associated with other recall-based self-report techniques such as interviews or traditional surveys [6]. Moreover researchers are not present during the ESM evaluation. Their involvement typically takes the form of interviews at the beginning and end of the study.

ESM combines the ecological validity of naturalistic observation with the descriptive nature of diaries and the precision of scaled questionnaires ([7], page 71). According to Delle Fave et al. [7] ESM has two main advantages. The major one is the real-time assessment of the experience, and this allows to

avoid recall biases typical of retrospective reports. The second advantage is the repeated assessment of the experience over time, which improves the quantity and quality of gathered data. We can mention a third advantage, highly relevant when participants are children: without needing on site facilitators for running the evaluation, ESM minimizes suggestibility. Still, according to the same authors, there are also two main disadvantages: attrition (i.e. the participants may drop out from the study or not respond to some questionnaires) and obtrusiveness (i.e. the experience/activity to be assessed is inevitably interrupted by the administration of the questionnaire).



Date:	Time Beeped:	Time Filled Out: am/pm

As you were beeped ...
What were you thinking about? _____
Where were you? _____
What was the MAIN thing you were doing? _____
What other things were you doing? _____
WHY were you doing this particular activity?
☐I had to ☐I wanted to do it ☐I had nothing else to do

Indicate how you felt about the main thing you were doing:

	low									*high*
Challenges of the activity	0	1	2	3	4	5	6	7	8	9
Your skills in the activity	0	1	2	3	4	5	6	7	8	9
Was this activity important to you?	0	1	2	3	4	5	6	7	8	9
Were you satisfied with how you were doing?	0	1	2	3	4	5	6	7	8	9

Describe your mood as you were beeped:

	very	*quite*	*some*	*neither*	*some*	*quite*	*very*	
Alert	O	o	.	-	.	o	O	Drowsy
Happy	O	o	.	-	.	o	O	Sad
Active	O	o	.	-	.	o	O	Passive
Involved	O	o	.	-	.	o	O	Detached

Figure 2.2) Selected sections and items of the Experience Sampling Form (ESF) (from Moneta [39])

ESM has been widely used in flow research and researchers have traditionally used it to understand aspects such as mood, time use, and social interactions. It is now gaining popularity in the HCI field where it has been used for different purposes such as understanding people's information needs while on-the-go [5], building predictive user models [26], capturing users feedback on mobile phones' usage [14] or investigate quality of experience in virtual environments [15].

Another variant of diary methods is the *parent evaluator method*. As the name itself suggests in this method the children's parents are required to keep a diary regarding the use of the product. The is specifically intended for children around age 4 to 6, who are too young to read and too young to execute written instructions. As admitted by the same authors, the method is still unproven; it has potential but also poses several challenges [34]. Parents are prone to treat the session as a test for their children. Furthermore their reports might be unconsciously biased by the mental image they have of their children (i.e. *"every child is the most beautiful in his/her mother's eyes"*). In fact researchers commonly agree that *"information on children's opinions, attitudes, and behavior should be collected directly from the children; proxy reporting is no longer considered good enough if children can be interviewed themselves"*. [31]

Inspection Methods [34]

Inspection methods – also known as walkthrough methods – are those where one or more experts analyze the designed interaction with the goal of fixing (usability) problems and improve it. An *expert* in this context is someone who is trained in the use of the evaluation method, is not a user, and preferably is not a designer of the product being evaluated. Therefore the evaluation is not empirical, so it does not require children to use a product or prototype, and neither requires calculating quality metrics or running simulations. Inspection methods are a good option when it is difficult to involve children in the evaluation process, but it must be bore in mind that relying exclusively on the judgment of experts carries some risks.

In this class of method falls *heuristic evaluation*. The essence of heuristic evaluation – as originally devised by Nielsen and Molich [43] – is to apply an appropriate set of heuristics (i.e. generic interaction design guidelines) and to examine the product or prototype to see whether, how, and how severely it violates them. Each of the problems found in this way is likely to be a problem for the actual users as well, so the evaluator can suggest a corresponding design improvement.

The heuristic evaluation method assumes the existence of a set of heuristics[5] that instill good design practice for the domain of interest. While this may be true for adults, where the users are children and the evaluation focus extends beyond usability, there is much less established design

[5] Providing a comprehensive review of the many existing sets of heuristics is out of the scope of this chapter: for a list the reader may refer to any good HCI textbook

knowledge on which to rely. There has been very little research done on this topic[6], so it is a good idea to be cautious and aware that this method has limitations. When possible it is always preferable to include children in the evaluation. As adults, we should keep in mind that we look at things from a completely different perspective from that of a child and we cannot pretend to be experts in what it means to be a child today.

Another inspection method is *Personas*. The main idea behind personas is to describe an archetypal user in a compelling and succinct way, making it possible for members of the design team to rely on a shared understanding of the needs and goals of this fictional persona. The argument is that when designing for a specific persona it is easier to make deliberate and coherent design choices. This type of inspection can help uncover usability problems, but it can also allow for broader discussions relating to appeal, preferences, and even the broader context of the interaction: where the product is used, who else is present, and so on. Clearly, there is little rigor in this process, which carries the danger that arbitrary conclusions may be made.

A typical argument for using inspection methods is that they are cheaper to run than tests. However it is useful to remember that inspection methods are based on predictions regarding how users will experience a product. Sometimes it is hard to get such predictions right, especially when the intended users are children, this prediction becomes especially hard, requiring insight into children's changing abilities at different ages. Another limit of this category of methods is that the context, user preferences, knowledge, and habits are largely neglected. During actual use all these factors may cover expected problems or make them more severe than anticipated. To avoid being misled a general advice is to take a conservative approach and combine inspection methods with empirical tests (i.e. triangulation) but this may contrast with the main argument in support of these methods, namely their limited cost.

[6] Currently there is no special set of heuristics for the design and evaluation of interactive products for children, with the only exception of Gilutz and Nielsen's usability guidelines for websites for children [16]

2.4 Summary of the Chapter

This chapter began with an analysis of the existing research on eBooks for children. From the review it emerged that research on eBooks is mixed both for what concerns the effects of eBooks on reading comprehension and reading attitudes. We also identified some unexplored areas of research, among which the study of the long-term effects of eBook on children – upper elementary pupils in particular. The main fact that emerges from our literature review is that the body of research on children's engagement with eBooks is rather thin, and that eReading for pleasure more generally remains underexplored in the HCI literature. Therefore more research that focuses on children reading eBooks for pleasure is needed.

As our research project involves designing a new concept of eBook we reviewed the methods and techniques most often used by CCI researchers to involve children in the technology design process. Starting from the definition of the concepts of Participatory Design and Collaborative Design, we reviewed those methods that have been adopted and/or adapted for children such as Bluebells, Bonded design, Cooperative Inquiry and Children as Software Designers. After discussing the advantages and disadvantages of each method, we described the techniques most often used to co-design with children.

The final phase of our research will involve the evaluation of the eBook that we designed. Therefore in the last section of the chapter we looked at the methods CCI researcher use to evaluate technology for children. Six main classes of methods can be identified: recording and logging, observation methods, verbalization methods, simulation methods, survey methods, diary methods and inspection methods. For every class of methods we described the concept behind them, their advantages and disadvantages and in which circumstances their use would be most appropriate.

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Chapter 3

Theoretical Framework

Prior to describe in detail the methods and techniques we used to design and evaluate the eBook prototype, we deem important to delineate a theoretical framework that – drawing from research on leisure reading with paper books – would allow an empirical analysis of the reading experience with eBooks. In this chapter we will present a brief review of the most important works on reading motivation and leisure reading, and then we will look at existing psychological theories, which might help us to better understand the concept of reading engagement.

3.1 Reading Motivation and Enjoyment

Given the complexity of human mind, there are many factors which can influence people reading behavior; but an essential one is motivation. Motivation is different from the more general concept of interest and from the one – even more general – of attitude: it is the inner force that activates/triggers a behavior or act. According to Guthrie and Wigfield [14] motivation is crucial for the activation of reading behavior and for children's engagement with books. Reading motivation has a multifaceted nature and includes aspects such as intrinsic and extrinsic motivation as well as social motivation, goals for reading (e.g. knowledge acquisition, conceptual understanding) and self-efficacy (i.e. confidence in your own capabilities) [14]. Even though these motivational facets are independent they often cluster together [14].

Extrinsic motivation means that the behavior is instrumental to some separable consequence, rather than being satisfying in its own right [8] while *intrinsic motivation* means doing an activity for its own sake, with a full

sense of volition. Self-Determination Theory (SDT) distinguishes these two types of motivation according to their perceived *Locus of Causality*: from a fully external one (extrinsic motivation) to a fully internal one (intrinsic motivation). When it comes to reading, extrinsically motivated reading is the reading that one does for recognition, for grades or for competition [42], while intrinsically motivated reading is the reading that one does to get pleasure from or because enjoys the act itself.

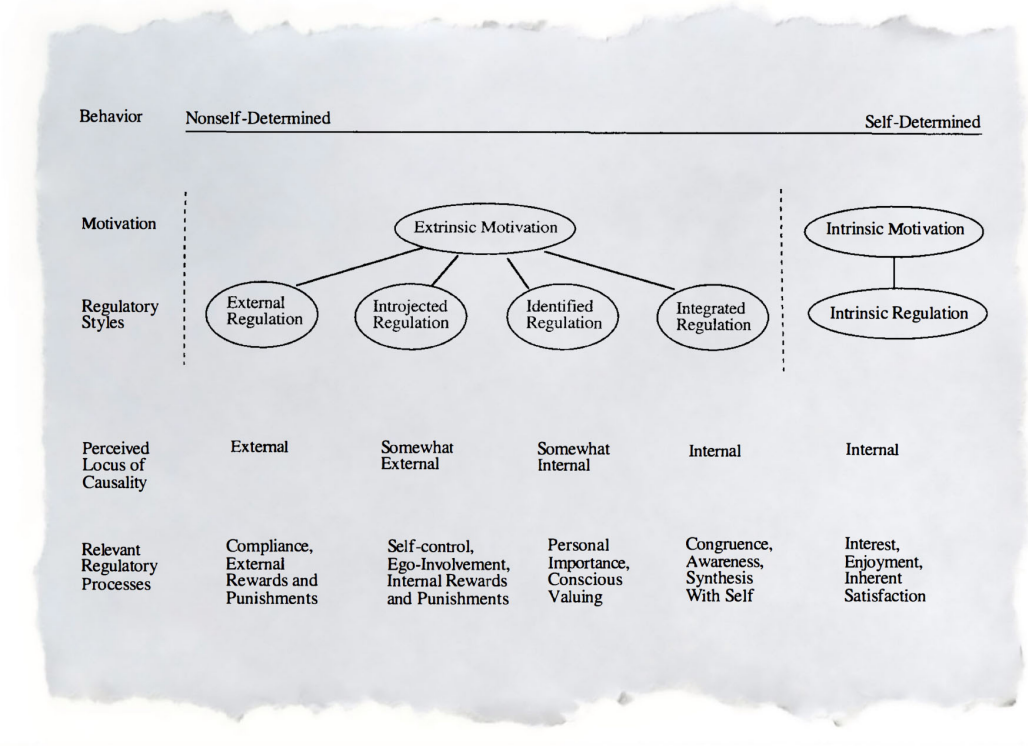

Figure 3.1) The Self-Determination continuum showing types of motivation with their regulatory styles, loci of causality and corresponding processes (adapted from Ryan and Deci [32])

There is evidence that both intrinsic and extrinsic forms of motivation may predict amount and breadth of reading [42], however some studies found extrinsic motivation to be negatively associated with leisure reading, suggesting that children who read for the outcomes of reading are less likely to get enjoyment from books [4]. Evidence from previous studies confirms the positive contribution of intrinsic reading motivation, and the relatively small or negative contribution of extrinsic reading motivation, to reading behavior [36]. In addition *"Oldfather and Dahl (1994) and Turner (1995) portrayed students' intrinsic motivation, referring to their enjoyment in*

reading for its own sake, which is essential to engaged reading" [14]. This evidence provides a first clue on the role of intrinsic motivation in fostering engagement while reading.

Wigfield and his colleague Guthrie [14,42] depicted children's intrinsic motivation for reading as a multidimensional construct and identified three main dimensions relating to it. The first one is curiosity, namely the children's desire to learn and understand the world around them. The second one is desire for challenge, for instance the desire to figure out the plot of an intricate story or to assimilate new/complex ideas in the text. The third one is involvement which refers to children's enjoyment of immersion or absorption in a text – often referred to as "getting lost in a book" [7,26].

As reported by Clark and Rumbold there is evidence that:

> *"Readers who are intrinsically motivated are more likely to find a variety of topics that interest them and to benefit from an accompanying sense of pleasure (Hidi, 2000). Studies have linked intrinsic reading motivation to: greater reading frequency and greater breadth of reading (Hidi, 2000); greater reading enjoyment (Cox and Guthrie, 2001; Wang and Guthrie, 2004); greater retention of key information (Guthrie et al., 1998); greater persistence in coping with difficulties, mastering the required skills and becoming self-determined in reading tasks (Deci, 1982)."* [4]

This seems to confirm the idea that intrinsic motivation is linked with enjoyment and pleasure while reading. However the two should not be confused. Enjoyment requires an active involvement in the activity and depends on the presence of challenges to be sustained. Pleasure, on the other hand, is homeostatic: pleasurable experiences – like resting on the sofa watching TV or eating a delicious cake – do not require complex skills and can be "passive" (i.e. they do not require a relevant amount of cognitive resources) [6]. Since leisure reading requires the active involvement of the reader (e.g. choosing the book, identifying with the characters, trying to recreate visually the places and the events described, anticipating turns of the plot, etc.) and a relevant amount of cognitive resources, the term enjoyment instead of pleasure should be used to identify a pleasing reading experience. So instead of speaking of "reading for pleasure" it would be more appropriate to say "reading for enjoyment".

As a matter of fact the *Uses and Gratifications* literature offers a great deal of research identifying enjoyment as a primary reason for media use

[39]. Media enjoyment as interpreted by uses and gratifications research include the apparent contradiction that media are both arousing and relaxing [39]: arousing in the sense that the user is constantly challenged in order to sustain enjoyment, and relaxing since one is freed from anxiety of everyday life. This applies to leisure reading too as it is generally seen as source of escapism (or reading trance), typically due to the intense and focused attention that the activity of reading requires [26]. In other words, when a person is engaged in what he or she is reading there is not enough attention left over to allow that person to process any information but the activity itself (). Therefore the worries and frustrations of everyday life are temporarily removed from awareness, and this may explain the seeming paradox of an arousing and – at the same time – relaxing activity.

Csikszentmihalyi offered a theory in which enjoyment is also conceived as both arousing and relaxing [39]. What Csikszentmihalyi observed is that when people report some characteristic experiential state that distinguishes the enjoyable moment from the rest of life, the same dimensions are remarkably similar across different settings (e.g. work and play). In other words, the phenomenology of enjoyment seems to be a panhuman constant [6]. Csikszentmihalyi called this state of consciousness a *flow experience*, because many of the respondents said that when what they were doing was especially enjoyable it felt like being in a flow. Consequently, the theoretical model that describes intrinsically rewarding experiences has been called the flow model [6].

In the next section we will discuss more in detail the flow theory and afterwards we will see why it is so relevant for the purposes of this study.

3.2 Flow Theory

Flow – or *optimal experience* – is defined by Csikszentmihalyi [7] as a mental state of deep enjoyment and intense engagement in a certain activity, where most of a person's attention resources are devoted to accomplish that activity. The original account of flow included eight major component that people often reported when asked to reflect on how it feels when their experience is most positive [7]. More recently Nakamura and Csikszentmihalyi [25] have distinguished between conditions and characteristics of flow. The conditions (or antecedents) of flow are internal states and perceptions that precede and foster the flow state but are not themselves expressions of flow [22]. These include:

- **challenges/skills balance**[1]: there should be a balance between challenges presented by the activity – as perceived by the doer – and self-perceived personal skills [7] so that one sees the activity as something feasible;
- **clear goals and immediate feedback**[2]: one should be able to identify clear proximal goals and the activity should then provide immediate feedback so that one is constantly aware of the progress being made [25].

Under these conditions, one may experience internal states and perceptions that are theorized to be caused by / characteristics of flow [22]. They can be described as follows:

- **focused concentration**: intense – if not complete – and focused concentration on the activity at hand that leaves no attentional resources available to process information that are not relevant for the activity [25] – one is almost insensitive to distractions;
- **merging of action and awareness**: this can bee seen as a by-product of the previous point since: *"When all a person's relevant skills are needed to cope with the challenges of a situation, that person's attention is completely absorbed by the activity. […] As a result, people stop being aware of themselves as separate from the actions they are performing"* [7];
- **loss of self-consciousness**: concern for the self disappears as a consequence of the complete focusing of attention: *"loss of self-consciousness does not involve a loss of self, and certainly not a loss of consciousness, but rather, only a loss of consciousness of the self. What slips below the threshold of awareness is the concept of self, the information we use to represent to ourselves who we are"* [7];
- **sense of potential control**: a sense that one can control his or her actions, that one can in principle deal with the situation because he or she knows how to respond to whatever happens next [25] – what is relevant is the possibility rather than the actuality of control;
- **time distortion**: the perception of temporal experience is distorted so time no longer seems to pass the way it ordinarily does [25] – typically when in flow one is oblivious to the passage of time;
- **autotelic activity**: experience of the activity as intrinsically rewarding, in other words one undertakes the activity for its own sake not because of its consequences [25].

[1] In the context of flow theory he term "challenges" should be understood as "opportunities for action".
[2] The words goals and feedback has to be interpreted in a broad sense.

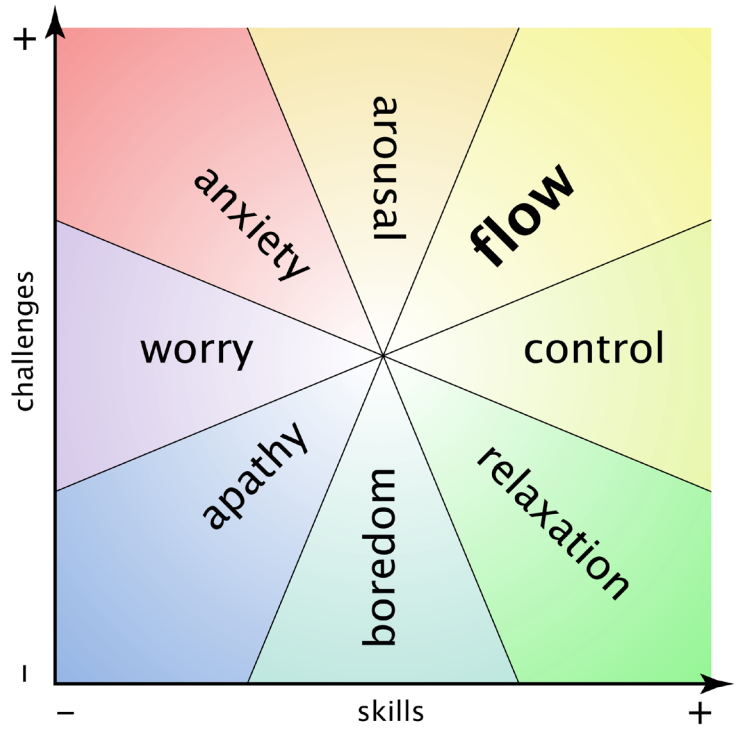

Figure 3.2) Graphical representation of the Experience Fluctuation Model, one of the possible operationalizations of the flow concept (adapted from Moneta [22])

Establishing a balance between perceived action capacities (skills) and perceived action opportunities (challenges) is probably the most important precursor for entering in a flow state. When challenges exceed skills, one may get worried or anxious; when challenges are below the skills, one may simply get bored or even worse apathetic (see Figure 3.2). Experiencing anxiety or apathy presses a person to adjust his or her level of skill and/or to change the activity in order to adjust to the level of challenges, escape the aversive state, and reenter flow [24].

Because a person who is undertaking an activity automatically master the skills required by it, the challenge/skills balance is a "dynamic" condition. Following the growth in skills, to maintain the balance that characterize the optimal experience, an individual will search for increasingly complex challenges, leading to the progressive improvement of related skills. The optimal level of challenge stretches existing skills (cf. Vygotsky's theory on the *Zone of Proximal Development* [40]), resulting in more complex capacities for action. This factor distinguishes the flow model from theories that define optimal challenge in terms of a homeostatic equilibrium: a flow activity

provides a system of graded challenges, able to accommodate a person's continued and deepening enjoyment as skills grow [25]. In turns, experiencing flow encourages a person to persist in and return to an activity because of the experiential rewards it promises, and thereby fosters the growth of skills over time [25].

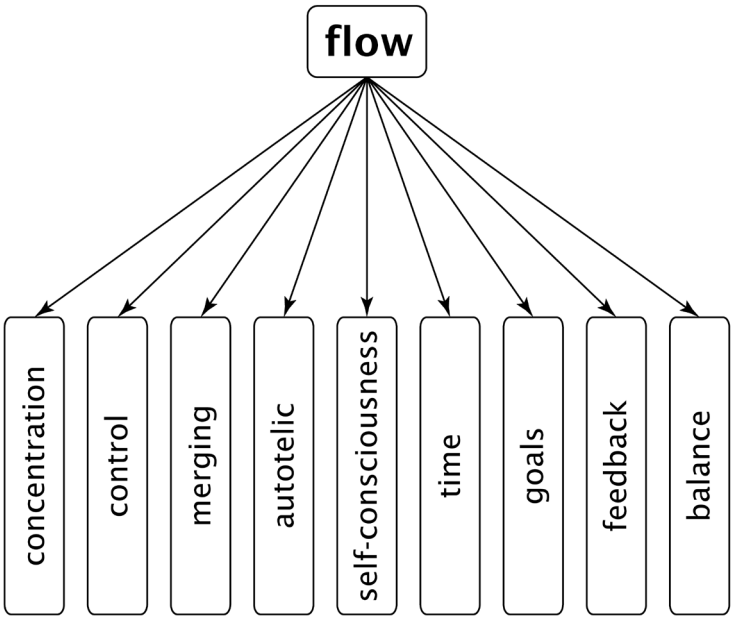

Figure 3.3) The single-factor componential model of flow (adapted from Moneta [22])

Although the concept of flow remained stable since its inception, the models of flow that researchers developed in conjunction with the measurement methods changed substantially over time [22]. There is a certain level of disagreement among researchers as to how flow should be operationalized and measured [10,22]. Figure 3.2 above is based on the *Experience Fluctuation Model* (often referred to as the "octant model") (Massimini et al., 1987; as cited in [22]) and has been used just in order to explain the challenges/skills balance concept. In the current study we will actually refer to the *single-factor componential model* (Jackson and Eklund, 2002; as cited in [22]) where flow is modeled as a single construct starting from all the components originally identified by Csikszentmihalyi (see Figure 3.3). Later in this chapter we will explain the reasons for this choice.

3.3 Flow and Reading Engagement

At this point the reader might wonder where all this discussion around motivation, enjoyment and flow is leading. As written in the introduction (see Section 1.3) the overall goal of this research is to design a new concept of eBook that provides an engaging user experience. We defined user engagement in Section 1.6 basing our reflections on the work of O'Brien and Toms [27]. One of the attributes of engagement discussed by O'Brien and Toms was motivation. They stressed that – in the context of user experience with technology – motivation and intrinsic interest are important qualities of engagement [27] and that user motivation has been shown to predict some attributes of engagement [28]. If we see motivation as the inner force that activates/triggers a behavior or act, then engagement can be seen as the inner force that sustains that behavior or act.

The same observations as above seem to be valid also in the context of readers experience with books since, as Wigfield pointed out: *"engagement in reading is greatly facilitated when individuals are intrinsically motivated to read and find personal meaning in the reading that they do"* [42]. To recap, it seems evident that intrinsic motivation is related to both enjoyment and engagement. We have also seen that the phenomenology of enjoyment can be explained by the flow model. Bringing all these indications together we can assume that a relationship between flow and engagement exists.

As a matter of fact the terms flow and engagement have been often defined in similar ways or used as synonyms in the literature. Researchers have described flow as: inclusive of engagement [19], a particular case of engagement [35], different manifestation of engagement [38] or as partially overlapping with engagement [34]. Despite the different interpretations of the relationship between the two concepts, we can speculate that both flow and engagement refer to some extent to the same latent underlying construct and are, therefore, related concepts. This relationship emerges even more clearly from the literature on media enjoyment. Green et al. [12] suggested that the phenomenology of media enjoyment can be characterized as a flow-like state, for Sherry [39] flow theory resonates with reports of media enjoyment and fits the experience well while according to Busselle and Bilandzic [3] flow offers a good explanation of narrative engagement.

3.3.1 "Getting Lost" in a Book

What does all this mean for the purposes of this study? To answer this question we have to think at when we are engaged in an enjoyable reading experience. Generally speaking – at least for what concerns immersive reading[3] – we can say that we have an optimal reading experience when we *"get lost in a book"*. This happens when we are completely engaged/involved in what we are reading, so involved that we may lose track of time, fail to observe events going on around us, and feel we are completely immersed in the world of the narrative [3]; moreover it feels like we can keep concentration effortlessly on what we are reading, and self-consciousness fades away. Interestingly enough, if we compare the description of "being lost in a book" with the description of flow reported before in this section, more than one similarity can be found. Although not originally intended as an explanation of engagement with eBooks, flow theory fits reading experience well, and resonates with reports of (optimal) leisure reading experiences – as already stressed in [21]. We can therefore understand why reading is one of the most widely reported flow activity in the optimal experience literature [6,21].

In the light of what we discussed, it appears that flow can offer a good conceptualization of reading engagement and that flow theory can provide a valid foundation for the evaluation of eReading experience. In other words, we deem "being in flow" as a good indicator of an engaging reading experience. As indicated by O'Brien and Toms [27] engagement has more than a few similarities with the concept of flow; with the main differences being that flow involves intrinsic motivation, sustained long-term focus and loss of awareness of the outside world, whilst engagement does not [27]. Considering that these characteristics are indeed peculiar of an engaging reading experience, it is confirmed once again that flow can be used with a certain amount of confidence as a reliable metric for the assessment of user engagement with eBooks.

Interestingly enough, flow theory meshes well not only with reading experience but with user experience with technology as well. In the next section we will look more in detail at how flow theory has been employed in HCI research.

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[3] *Immersive reading* is a sort of "deep" reading that is commonly related to narratives and novels and that requires a significant investment of time and concentration. It is defined in contrast to *extractive reading* which can be seen as an extension of search, where the primary purpose is to "extract" information from the text.

3.4 Flow in HCI Research

In recent years we assisted to an increasing amount of HCI research focusing on the positive aspects of technology. This new paradigm in HCI research is identified by the umbrella term user experience research, a term that emphasizes the focus on users and their experience with the technology and on the role of – ubiquitous – technology in people's lives [31]. Ideally the goal of UX research nowadays would be to help *"to create technologies that contribute to enhancement of happiness and psychological well-being"* [29].

As we wrote in the definition of UX in the first chapter, this new trend in HCI research focuses on positive aspects of users' interaction with technology rather than negative ones of traditional usability approach [1] mirroring a trend in psychology, where Seligman and Csikszentmihalyi argued for a "new" positive psychology [37], a psychology that focuses on human strengths and optimal functioning rather than on weaknesses and malfunctioning [15]. UX research – in the sense of a positive approach to HCI research – thus has to focus on how to create outstanding quality experiences rather than merely preventing usability problems: as there is much more to wellbeing than the absence of malady, so there must be more to UX than the absence of problems [15]. In other words one of HCI's main objectives nowadays is to contribute to our quality of life by designing for pleasure/enjoyment rather than for absence of pain/problems.

Being flow theory a predominant part of the positive psychology branch, it has attracted a great deal of attention from researchers in the HCI field. Webster et al. [41] were among the pioneers in exploring a possible application of the flow construct in HCI. They explored the dimensionality of the flow construct within human-computer interaction and its factor structure and correlates. In the same years Ghani [11] used the flow framework to investigate the dimensions of positive user experience, the factors that may affect it and the consequences it may lead to. In the same line of research, Hoffman and Novak [16] used flow to describe the experience of users while navigating the World Wide Web (WWW). This model provides insight into what creates compelling online experiences (i.e., congruence of skill and challenge, interactivity, vividness, and motivation); the nature of a compelling flow experience (i.e., involvement, attention, telepresence, and flow), and the outcomes of the experience (i.e., increased learning, perceived behavioral control, exploratory mindset, and positive subjective experience) [17].

3.4.1 Modeling Flow

Subsequent research has expanded on these early models. Even though researchers generally agree on the conceptual definition of flow as presented by Csikszentmihalyi, there is a lack of consistency in operational definitions of flow used by different researchers. Through a review of the literature on the investigation of flow in online environments, Hoffman and Novak [17] identified 22 (!) different conceptual and structural models developed by researchers . In these models flow has been characterized both as a *unidimensional* or a *multidimensional* construct[4].

In the first case flow is seen either as a unidimensional construct with a set of ancillary constructs that serve as antecedents or as an aggregated of different constructs related to flow into an overall measure. The main advantage of this characterization is that it makes relatively easy to measure flow (e.g. through questionnaires), while the disadvantage is that it blurs the distinction between the various components of flow [17]. When flow is characterized as a multidimensional construct researchers measure each of the constituent constructs individually, and employ structural models to test whether these constructs define a higher-order factor that can be interpreted as flow. The advantage of this approach is that it allows statistical tests of whether the constituent constructs should be viewed as part of a higher-order factor measuring flow or not. The disadvantages are the increased complexity of data collection, and the dependence of the resulting structural model on the specific constructs that were collected [17]. Hoffman and Novak [17] recommend to use multi-dimensional characterization of flow whenever possible, but a simpler mono-dimensional approach can be used when is necessary to reduce the data collection burden in repeated measures designs (such as with the Experience Sampling Method). In the light of this the reader may now understand our choice to refer to the *single factor componential*[5] model of flow. For our research goals we do not see the need to use a multidimensional model, so using a mono-dimensional model allows us to simplify the data collection process and reduce the burden on the participants.

Also Finneran and Zhang [10], through a critical review of the literature on flow in computer-mediated environments (CME), evidenced the lack of

[4] As we have seen before in this chapter Jackson and Eklund (2002; as cited in [22]) distinguishes between single-factor componential models or multi-factor componential models. Despite the different terminology, it is the same distinction as the one made by Hoffman and Novak [17]

[5] Or *derived unidimensional* according to Hoffman and Novak's terminology [17].

consistency in operational definitions of flow. They also found that most of the existing studies on flow in CME do not clearly distinguish between an activity and a task or between a task and an artifact, a crucial distinction when the relationship between a person and the activity is mediated by a third entity – such in the case of human-computer interaction. To address this issue, in a different publication the same authors suggest that activity needs to be divided into two components: the task or main goal of the activity and the artifact that assists the user in accomplishing the task [9]. But for Finneran and Zhang the use of flow in HCI research present also some interesting promises:

> *"Researchers had the foresight to use flow theory as a way to understand human behavior with computers and thus inform better ICT design, training and use. Their studies indicate the great promise that flow can yield in increased learning, improved attitudes, increased computer use, and overall, positive experiences within a computer-mediated environment. The benefits of flow experiences are clear. If we can clarify our thinking and improve our methods for studying flow, we will certainly gain better understanding on how to design effective human computer interactions that are conducive to these optimal experiences."* [10]

3.4.2 Flow and Videogames

After Finneran and Zhang's review of the literature – published almost a decade ago – many other researchers have tried to use flow a theoretical lens to study UX. Not surprisingly the vast majority of these studies are focused on UX with videogames – for an up-to-date synthesis of the literature on the topic see Nah et al.'s paper [23] – and the reason is simple: games have intrinsic characteristics that parallel those peculiar of the optimal experience – as we reported in a previous section – so they have a far better potential for a flow experience than most interactive systems. It was therefore natural that many researchers (including Csikszentmihalyi himself) have seen a link between flow and (video)games – see Cowley et al. [5] for a shortlist. Sherry [39] suggests that Csikszentmihalyi seemed to have video games in mind when he developed the concept of flow in the 70s – though games were not to exist in their popular form for several years. Among the various studies

that explored flow in computer games, one is particularly relevant for this project.

The study is the one conducted by Inal and Cagiltay [18] who examined children's flow experiences in an interactive social game environment to understand the role of game-based applications in educational settings. A total of 33 children aged from 7 to 9 years participated in the study for 6 weeks. Data were collected through observations and interviews. In order to measure the flow experiences of the children, items of a flow scale were administered to the children through interviews. Apart from the results – for which we refer the reader to the original paper – this study is highly relevant to our project because it represents one of the first studies of this kind which involves children, showing that with the appropriate methods it is possible to assess flow also with this particular population.

3.4.3 Towards a "Positive Technology"

While flow theory has been extensively employed in HCI research on online customer experience and player gaming experience, the same cannot be said for other HCI research strands. We feel that in the last few years scholars and practitioners may have neglected the potential of studying flow in HCI despite the fact that previous studies where it has been investigated showed promising paths of research. As summarized by Finneran and Zhang [10], previous research showed that within a computer-mediated environment the experience of flow lead to increased: exploratory behavior, communication, positive affect, learning, satisfaction and technology acceptance.

In an attempt to revive interest around flow and positive psychology within the HCI research field, Riva et al. [29] contributed with a paper that can be seen as a research manifesto for what they called *"Positive Technology"*. In the paper the authors contend that the quality of the experience should be the guiding principle in the design and development of new technologies, as well as a primary metric for the evaluation of their applications [29]. They suggest that the discipline of positive psychology provides a useful framework to address this challenge.

Specifically Riva et al. argue that it is possible to use technology to influence the user experience on three different aspects [2,29] (see Figure 3.4):

- **hedonic**: technologies are used to induce positive and pleasant experiences;
- **eudaimonic**[6]: technologies are used to support individuals in reaching engaging and self-actualizing experiences;
- **social/interpersonal**: technologies are used to support and improve social integration and/or connectedness between individuals, groups, and organizations.

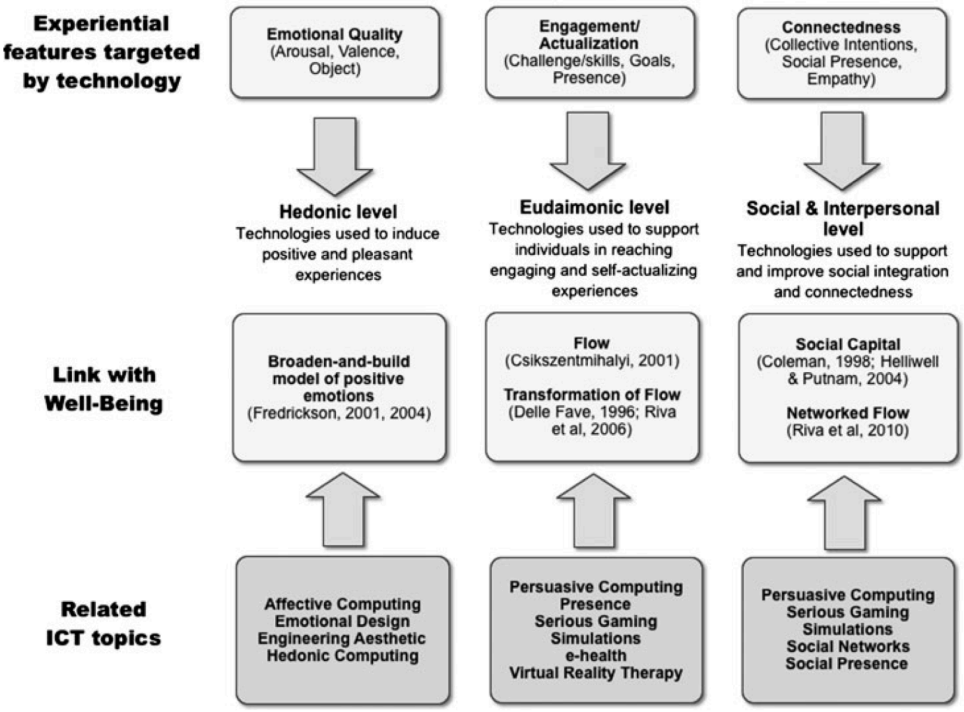

Figure 3.4) A diagram showing the Positive Technology domain categorized according the experiential features targeted by technology (from Riva et al. [29])

The idea brought forward by Riva et al. is not completely new as the concept of UX itself implies a positive approach to technology (as discussed at the beginning of this section and evidenced by other authors [15,33]). What is different is that Riva et al. explicitly propose a new paradigm where the theories of positive psychology are used to inform the design and

[6] According to Riva et al. [29] technologies that potentially support the users to reach flow are specifically targeted at the eudamonic aspect of UX.

development of new technologies [29]. More recently, Romero and Calvillo-Gámez [30] showed an interesting path of research by presenting a view of flow based on notions of phenomenology and embodied interaction which may provide a framework to analyze and situate work on flow in computing. For the authors this would help researchers to understand the different interpretations of the flow concept and support the design of new studies on flow in this area [30]. Other researcher speculated that a better understanding of the flow phenomenon would help information and communication technology (ICT) designers to design products that will lead users to optimal experiences [10] and also that flow can provide an useful support in evaluating UX since it captures the holistic aspect of UX and provides an important supplement to more traditional, fine grained variables, such as beliefs and attitudes [13].

In conclusion, we agree with those researchers who see flow – and positive psychology more in general – as a promising perspective from which one can approach the study of people experience with technology. In other words, by paraphrasing Markopoulos, we believe that: *"Maintaining flow can guide the design of interaction – e.g. how to maintain the right level of challenge, how to provide clear indications of action and progress – but can also guide the assessment of enjoyment throughout the activity"* [20].

3.5 Summary of the Chapter

This chapter attempts to provide references in support of our choice to use flow theory – more precisely the single-factor componential model of flow – as the framework to inform and guide the design and evaluation of eBooks during this research project. We started from the very basic concept of reading motivation and we saw that it is a multifaceted construct but intrinsic motivation plays a major role and is linked with many benefits connected to reading, including pleasure and enjoyment. We then described the concept of media enjoyment and its similarities with the concept of flow which we described in detail in an ensuing section. We showed that flow is an important concept for this study because it explains the phenomenology of enjoyment and, more important, it offers offer a good conceptualization of reading engagement and a valid foundation for the evaluation of eReading experience. Having determined that, in the final section of this chapter we looked at how flow theory has been employed in HCI research. We saw that flow has attracted a great deal of attention from researchers in the HCI field

because it provides a theoretical lens that allows to focus on the positive aspects of the user experience, in line with one of the tenets of modern UX research. This great interest generated a number of attempts to model and/or operationalize but various reviews of the literature evidenced a lack of consistency between the various interpretations of flow. Recent researches tried to address this issue.

We hope to have convinced the reader on the fact that flow is a promising framework for modeling and assessing eReading experience given the similarities between flow components and ludic reading characteristics. Our intended approach is in line with a new paradigm that proposes to use the theories of positive psychology (among which flow theory) to inform the design and evaluation of new technologies. Drawing on the indications emerged in this chapter, in the following one we will provide the rationale and more details on the research methods we employed.

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Chapter 4

Understanding Children's Reading Experience

From this chapter onwards we will describe in detail the work that has been conducted within the HEBE project. The project started with a study stage[1] where we explored existing reading practices of children to get a first insight on their experience with books so that we could complement the information we obtained from the review of the literature. This stage was specifically aimed at gathering more information on the population of users and the context of use, while at the same time studying the role of digital technologies in children's lives and whether and how these technologies are integrated in their reading practices. The overall goal of this stage was to ascertain what kinds of values and aspects children value the most in their reading experiences so that they could be used as a source of inspiration for the next stage of the project.

4.1 Methodological Approach

The purpose of this stage was mostly exploratory, and a qualitative approach was followed. In an initial phase we employed unstructured naturalistic observation [6] and we observed groups of pupils engaged in leisure reading at school. We looked at children's reading experience in a holistic way, trying to identify all those aspects and nuances that could be useful for our purposes. Our observations were recorded through note taking, and notes were then analyzed to uncover the most recurrent patterns. We also

[1] Refer to Section 1.7 to see how the project and this dissertation have been organized

conducted few focus group interviews with the pupils and their teachers to gather that additional information that could not be obtained from observation, such as for instance children's likes and dislikes of reading or how they imagine reading in a technological future. Also in this case we used note taking to record interviews.

In a later phase we worked with a more restricted set of participants and we followed a different approach to be able to study children's reading experience in a more natural and informal settings than that of a school classroom. We wanted to study the real situations where children usually read books for leisure so to gather additional information about the reading context and some initial indications on the impact of technology on reading practices. For this phase we used an inquiry method inspired by KidReporter by Bekker et al. [1]. As we described in Section 2.2.3, this method enables children to contribute their opinion to a design problem through a choice of activities that finally results in a newspaper reporting on the children's idea about a topic [1]. We enhanced KidReporter technique by taking advantage of photo/video recording capabilities of tablet computers. The study was followed by a focus group where we discussed what children reported through videos and pictures. Participants' demographic data, reading preferences and habits were elicited through questionnaires.

4.2 Participants and Setting

The first phase of the investigation involved two classes and the respective teachers of a primary school in Lugano (Switzerland), with children ranging from 9 to 11 years old. Children this age are in the so-called *concrete operational stage* [8] of cognitive development[2].

In total 45 children participated in the study (21 males, 24 females), 19 of them declared to be "strong readers" (they have read more than 12 books in the last year) while 7 declared to have read an eBook at least once. 40 children have (and use) a computer at home while only 8 have a tablet and none an eBook reader.

In a second phase we worked on with a more restricted set of participants: 10 children (7 females and 3 males) aged between 9 and 11 years old. All the children had some experience in using a tablet (3 actually had the device at home), and two of them have already read an eBook before

[2] See the definition of "childhood" in Section 1.6 of this dissertation for more details.

taking part in the study. More than a half of the children (6) declared to read more than 12 books per year, while only one child read less than 3 books in the last year (what is considered to be a "weak reader"). Only one child did not have a computer at home. For this phase children were volunteered from a population of regular users of a children's library in Lugano (Switzerland). In the same library we conducted the initial meeting and the follow-up focus group interview.

4.3 Procedure

This stage of the project took 4 months of time in total. The first phase lasted 3 months and observations were carried out on a weekly basis. We observed children reading in classroom, inside school hours specifically dedicated to leisure reading. In fact the teachers involved in the study integrated leisure reading with the other learning activities and reserved two hours per week to allow their pupils to read a book of their choice. Children could also bring the book home to continue reading it. When we joined this activity as observers we provided participants with an additional set of 50 (paper) books carefully selected by various experts in children literature (i.e. librarians, book sellers, teachers, etc.). During the various meetings we (the author and another researcher) observed children's reading experience and noted down their observations. Once a month the observation sessions were replaced by focus group interviews with the pupils and their teachers where we tried to have our observation confirmed and to integrate them with additional information.

For each of the two classes me managed to carry out 8 observation sessions and 3 focus group sessions. Initially we observed the reading experience with paper books while in the final 2 sessions we provided participants with tablets to observe their first-time experience with eBooks in various formats and to obtain a preliminary feedback aimed at informing the following stages of the project. In the final focus group we discussed with the participants the various pros and cons they see in reading paper versus electronic books.

This phase was followed by a second phase of one month where our goal was to get a better insight on the context where reading takes place. This phase started with a meeting at the children's library we mentioned in the previous section where we met the 10 children (and their parents) who volunteered to take part in the study, explained them the purpose of the

study and what they had to do to collect the data we needed. We provided all the participants with a tablet (i.e. iPad® 2) to keep for the duration of the study so that they could have become familiar with the device, use it at home and have an experience with eBooks in various formats. On each device we installed 25 eBooks written in Italian: 8 in PDF format (an electronic copy of the paper book without any interactive feature), 14 in EPUB format (where the content can be re-flowed and there are some opportunities for interaction) and 3 in the form of applications (where the book is enriched with highly interactive features as well as multimedia content). Each child, individually and autonomously, was asked to use the tablet to make a one-week photo/video report to describe how, where and when he/she usually read books. We instructed children on how to use basic features of a presentation iPad® app (Keynote®) so that they were able to add captions to the pictures and videos and to arrange them as a slideshow. This phase ended with a meeting at the children's library (see Figure 3.1) where each child showed his/her report to the other participants and where we set up a discussion to figure out if the reading practices of the children were characterized by common aspects, and if the use of a tablet for reading eBooks had somehow influenced their reading practices.

Figure 3.1) A phase of the focus group during the follow-up meeting.

The idea to use tablets to enhance the KidReporter technique came after we noticed that children we worked with in the previous phase liked very much to take pictures and record videos with tablets. We have seen this as solution to provide children with an easy and intuitive way for expressing their opinion and reporting on their experience – so that their task becomes less burdensome.

4.4 Outcomes

By observing pupils reading at school we have been able to get a better understanding of children's leisure reading experience. One of the first things we have noticed was that despite the study setting forced participants to share the same classroom with their classmates, reading was carried out as an individual activity. We actually observed some children forming small groups and reading one next to each other but we never observed children reading a book together and sharing the same book. Another interesting aspect we observed were the strategies children adopted to increase their focus on the text. Some children used to read the text out loud whispering what they were reading from the book; some children used to follow the fixation point on the page with the index finger; some other children from time to time dwelled on a page for a longer time, but almost never they went back to reread parts of the text they already read.

We must acknowledge that the school environment – not the typical environment where leisure reading takes place – influenced children's behaviour in various ways. It goes without saying that the presence of other classmates increased the opportunities for distraction, and in many situations we observed how children were easily diverted away from reading. The presence of the teacher might have influenced children's behaviour as well. In fact whenever they encountered an unknown word in the text or they did not understand a phrase, children asked the teacher for some clarification – this despite the availability of age-appropriate dictionaries in the class. Also our presence might have biased children since, as reported by the teachers, they were slightly quieter than the usual.

Even though we observed that reading was carried out individually, at the same time we noticed that children this age highly valued to share their reading experiences with their peers: they liked to disclose their reading taste and preferences and to tell about their favourite books, often they showed

and compared the book they were reading with their classmates. These observations are in line with what Kaplan et al. found in previous studies [5].

During the focus groups we discussed our observations with children and teachers. It turned out that the strategies they adopted to stay focused on the text are essential in this phase where their literacy skills are still developing: without reading aloud or following the text with a finger some of them would struggle to read. We also discovered that asking the teacher to explain unclear words and phrases was primarily due the "laziness" of the children who wanted to avoid the tedious process of searching for a word's definition in the dictionary. As for when they remained on a page for a particularly long time, it was either because they were spellbound by the story they were reading or simply because they were taking a break from reading – for instance by watching illustrations.

One of the questions we were not able to answer with observations and therefore we tried to address during the focus group interviews was: *"what do children like/dislike of reading for pleasure?"* It emerged that what they like most is the *spur to imagination* and the *pleasure to discover* they get from books, while what they like less is when they encounter tedious text sections/books. A remark of one of the participants is very well representative of the data we collected:

> *"I like books because they carry you away [in an imaginary world], no one can stop or disrupt you because your mind is wandering […] But it depends, some books are really boring. For instance I do not like history or science books, or books that are too complicated".*

In one of the focus group sessions we also discussed the strategies children adopt when choosing a book. According to what they told us they usually look at some key visual features – title, cover art, book size, font size – and read the blurb or quickly browse through the book in order to get a sort of preview of the content – both textual and visual. All this is very much in line with what other researchers have found [4,9]. They also carefully value age appropriateness of the book and usually consider the advice of the so-called *More Knowledgeable Others (MKO)* [10] – i.e. parents, teachers, strong-reader classmates, etc. Reading advices coming from peers seem to be less influential: in this last case *peer pressure* ("Do the other classmates like this book? Is it "cool"?) seems to be more relevant in influencing their behaviour.

In the last focus group, after the participants had the opportunity to use tablets to read eBooks, we discussed with them potential pros and cons of

reading from paper books versus electronic books. As we expected they were enthusiast of reading eBooks on tablets, mainly because of the *novelty effect* [2] and of the fact that they saw the device as a "tech toy" they could use not only to read but also to play. However, they were able to identify some potential drawbacks of reading a book on such device. The main concern was about its distracting potential, some children said that having various applications at their fingertips could divert the focus of their attention from the book. They also pointed out the strangeness of reading a book that is no longer a tangible object with its various dimensions such as weight, thickness, page size (even the "scent") and they evidenced the lack of some of the affordances of paper books, in particular not being able to immediately recognize at what point of the book they were just by comparing the thickness of the pages they already read with that of the remaining pages. Another aspect they evidenced is that quite surprisingly many of the eBooks commercially available do not have the same richness in colours and illustrations as printed books: colours are seldom used and in some cases even illustrations are rendered in black and white. Some children also pointed out *usability issues* they found in the few interactive/multimedia eBooks that were available on the device. In some cases user actions cannot be reversed and many interactive controls do not have enough affordance; in some other cases interactive elements are just embellishments without a specific purpose. With regard to this last point some children pointed out that additional features should be related to the story and contribute to it in some way.

When we asked children to think about the "eBook of the future", despite the difficulties in reasoning at such high level of abstraction, they came up with some interesting ideas, most of which in the direction of a better interaction and enhanced multimedia content. For instance a participant suggested to have eBooks where the user can model the plot and play a sort of adventure game [3] with the book, while another participant said that it would be nice if eBooks could *"talk"* and *"move"*.

The second phase of the study allowed us to gather more information about the context where children usually read for pleasure since in the first phase we worked exclusively in schools that, according to the data we collected, are not the typical context where reading for pleasure takes place. According to what children reported through pictures and videos (see Figure 3.2), it emerges that when they read for pleasure – both paper books and eBooks – they usually do it at home, with very few exceptions.

Figure 3.2) Some of the pictures that children included in their photo reports

Home seems to be the environment where children read most of the times. Despite being the book and the tablet computer two highly portable artefacts, children rarely read books while travelling or during daily commuting. It emerged that children do not necessarily look for a quiet place for reading as few videos showed children reading in the living room with the TV on and/or with other family members around. Some children complained about siblings interfering with their reading experience but no one expressed remarks about the noisy environment.

During the focus group we had the opportunity to discuss the above findings more in detail. Children did not report any particular reason why reading takes place mostly at home. An interesting aspect we discovered was at what time of the day participants usually read. Children reported that the

usual time slots dedicated to reading are during afternoon's snack-time (4-5 PM roughly) and after dinner before sleep-time (8.30-9.30PM roughly).

4.5 Discussion

As the title of the chapter itself may suggest, this stage of the study aimed at gaining a better understanding of the reading experience through the investigation of the various aspects of the reading experience. We also started to explore how children use and perceive eBooks. In this section we will discuss the implications of our findings and how they can be translated into general user requirements for the design of eBooks.

The fact that children did not engage in social interactions while reading suggests that enhancing eBooks with "social" features such as social networks and recommender systems might not be very effective in increasing children's engagement while reading. On the contrary, integrating some features to help young readers to stay focused on the text may be more beneficial since, as we have seen, children already adopt various strategies in that sense. For instance we may think of a function that reads the text aloud and at the same time visually marks the text that is being read. Another feature that might be worth to implement is an in-line dictionary, this would allow the child to easily retrieve the meaning of an unknown word (by simply tapping on it) without having to consult a dictionary and therefore disrupt the reading process. In designing the eBook we have nevertheless to be careful in order to preserve the spur to imagination and the pleasure to discover that traditional books provide to the reader. We need to make sure that the eBook is usable too, therefore traditional good practices of usability design should not be neglected.

With respect to the context of use, we found that children prefer to read books at home. We do not have an explanation for this as it could be due to a number of reasons, including the fact that children have a more settled life than adults, and they spend the most part of their days at home or at school. Yet this indication deserves attention as it may imply that issues typical of a mobile context of use – e.g. limited attentional resources [7] – are less relevant for an activity such as leisure reading, and this means that eBooks can be designed to be highly interactive and demanding in terms of attention.

For what concerns book choice, we had an overview of the factors affecting it and of the differences between choosing a book from a real

bookshelf and from a virtual bookshelf. In the latter the only information readers can get at a glance are: cover art, book title, author's name and sometimes the blurb. So with a digital bookshelf it would likely be more difficult for children to evaluate if the book matches their taste or if is appropriate for their age.

As children do not usually consider reading suggestions coming from peers, we feel that traditional recommender systems may not be effective with this particular age group. Event if we have evidence that children this age highly value sharing their experiences we will not investigate these issues further as they fall out of the scope of this project

In the following stages of this research project we will describe how we applied these observations to the design process and how we evaluated their impact in terms of readers' engagement.

4.5.1 Limitations

Not being able to extensively investigate reading experience with eBooks was the main limitation of this first stage. As written only 7 out of 45 children had ever read an eBook at the time the study started, and for practical reasons we were not able to provide each child with an eBook reader (we had only 10 iPads® available). In the light of this, we opted to observe reading practices connected with paper books and only in a later phase to provide children with tablets that they were still forced to share with other classmates.

As we already stressed, observations took place in a formal environment such as a school classroom during time-slots usually dedicated to leisure reading, and this –combined with the presence of the teacher and our presence in the role of observers – may have influenced children's behaviour to some extent.

As for the methods we employed in this phase, unstructured naturalistic observation proved to be suitable for our purpose, and participants were very collaborative and enthusiast to discuss their own experience with their classmates and us during the focus group.

Moving to the second phase of this part of the project, KidReporter technique used in combination with tablets showed to be very effective in gathering detailed information about the reading context. Children commitment was high and their reports were detailed and exhaustive. This said it was not the same as first-hand observation thus we had to rely on

their reports only. Also, in this phase the number of participants was smaller than in the previous phase. This was due to the fact that we wanted to provide each child with an iPad to bring wherever they wanted, so the number of participants was limited by the number of devices. Last, most of the children we worked with never read an eBook before, and it was the first time that they had a tablet all for their own; hence the influence of the novelty effect [2] should not be excluded.

4.6 Summary of the Chapter

In this chapter we explored the many facets and activities that contribute to the definition of reading experience. To this end we ran a study in two phases: the first consisting in observations conducted at school, and the second where children had to make photo/video reports about themselves reading for pleasure in a natural context. Our aim was to get a first overview of the reading experience of children and the context where it unfolds. We discovered for instance how children approached reading, the strategies they employed to stay focused on the text and how they dealt with unknown words. We also did focus groups to explore with children the pros and cons of paper versus electronic books and their idea of "eBook of the future". The second phase of the study allowed us to gather more information about the context where children usually read for pleasure, and we discovered that in most cases it corresponds to their home. We then discussed the implications of our findings and how they could be a source of inspiration for the next stage of this research project, which we will describe in the next chapter.

4.7 References

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Chapter 5

Participatory Design of a Children's eBook

Involving users in the design of new technologies is seen by many researchers as an important aspect in the development of new technologies [23]. This is especially true when the technologies are being designed for children, given the discrepancy between the way children and adults look at the world [19].

Although collaborative design methods are sometimes considered to be resource-intensive, the advantages in terms of innovation and appropriateness of design can outweigh these negative factors. As we have seen in our review of the literature (see Chapter 2) researchers have demonstrated the benefits of including children in the design process, therefore the real issue would seem to be not whether involving children is beneficial but rather "*how to more effectively engage them in the design process"* [17]. From our point of view engaging children more effectively means to allow them to have a voice in the design process, to empower them, to allow them to contribute to the design of new technology with more – and more meaningful – ideas. Our assumption was that we could design better eBooks by involving children as design partners.

5.1 Methodological Approach

It goes without saying that the methods and techniques we decide to use during the prototyping phase heavily influence the way children can give their contribution [4]. What differentiates the various participatory design methods and approaches – besides the different philosophies behind them – is the degree of user involvement throughout the design process. Children can be involved at different stages of the design process, and their level of involvement can vary; therefore they can have different roles and responsibilities in the design process [5]. According to Nesset and Large [17] *Cooperative Inquiry (CI)* is the method which entails the higher degree of involvement, where participants collaborate as design partners. This one of the two main reasons why we decided to use it. The other reason is that, as shown by our review of the literature, CI has a proven track record of effectiveness when used with children to develop a wide variety of technology.

Cooperative Inquiry is essentially a combination of techniques from different design methods, and it is *"grounded in HCI research and theories of cooperative design involving a multi-disciplinary partnership with children, field research, and iterative low and high-tech prototyping"* [17]. As we described in Section 2.2.2, various techniques have been developed and used in conjunction with Cooperative Inquiry. In this study we employed techniques as *Sticky-notes* and *Mixing ideas*. A detailed description of each technique can be found in Section 2.2.3 of this dissertation, but an aspect that all the above-mentioned techniques have in common, is the use of low-tech materials (e.g. paper) to develop low-tech prototypes. Thanks to the *long-term* partnership with our team of children, we explored different tools and techniques to create multiple versions of the same prototype. In particular, we had the opportunity to progressively introduce high-tech devices such as tablet computers in our prototyping workflow and to observe how these devices can be used as a tool for supporting collaborative design. We will describe what we did more in detail in the coming sections.

5.2 Participants and Setting

What we report in this chapter is the result of 5 months of work in cooperation with a team of 10 children, the same children who were involved

in the last part of the study stage we described in Chapter 4. Therefore the partnership with the children lasted for 6 months in total. For the entire duration of the study we met once a week for one hour and a half with our intergenerational design team. Meetings took place in a children's library (see Figure 5.1) in Lugano (Switzerland). We chose this location in order to work in an informal environment that was, at the same time, a location familiar to the participants.

Figure 5.1) The intergenerational design team at work in the children's library

Cooperative Inquiry advocates a design partnership in which adults and children are equal stakeholders in the design process [10]. Therefore we built an intergenerational design team composed by 10 children (7 females and 3 males in the 9 to 11 age range), 3 HCI researchers (who led the design sessions) and 2 librarians (who helped in the role of facilitators and also provided logistic support).

All the participants volunteered to be part of the team: before the study we posted an open call in the library where the study took place and in some primary schools in the local area. Occasionally, and depending on the goal of each session, children's parents and teachers were involved as well.

5.3 Materials

When we started planning the research we had to choose which eBook reader to use as target device for our prototype. Even though they are not eBook readers in the strictest sense, we chose to use tablet computers, i.e. iPads®. We believed a tablet computer would have allowed us more flexibility, both for what concerns the format of the eBook and for the possibility to embed multimedia content – not all the eBook readers currently available on the market support multimedia content.

When we decided to introduce iPads® in the prototyping workflow, we had to think of how to transform a tablet into a prototyping tool without making it too demanding for the children. We analyzed a set of application that could have been used for our purposes and our choice fell on a presentation software (i.e. Keynote®). Presentation software are used to display information – normally in the form of a slide show – and usually provide enough features to emulate software interfaces: this explains why they are often used by Human-Computer Interaction (HCI) researchers and practitioners for rapid development of high fidelity working prototypes [20]. The advantage of using presentation software to create prototypes is that they simultaneously offer ease of production and support detailed design through direct manipulation without the need for programming [6].

In the next section we will describe in more details how we worked to develop the eBook prototypes.

5.4 Procedure

The design activities we carried out can be classified into two different phases, each one characterized by the tools we used: paper prototyping or iPad® prototyping. The two phases, described more in detail below, were preceded by a couple of introductory meetings. In the first meeting we welcomed children, explained them the purpose of the study, gave to each of them a tablet, and answered all their questions. In the second meeting – after children spent one week to read various eBooks in different formats – we did a brainstorming to elicit "likes and dislikes" of current eBooks and to propose new ideas on how to improve them (see *sticky-note* technique).

5.4.1 Design Phase 1 (DP1): Paper Prototyping

Figure 5.2) Children working on a paper prototype

To approach DP1 – being the first time that children were involved in design team – we decided to start with a task that did not require any particular skill other than being able to read, write and draw. Children were divided in two groups – one female only, the other mixed-gender – and two adults joined each group. We assigned to each group a chapter of an illustrated printed book and the task was to use sticky-notes and colored markers to enhance the book with any sort of "magical" feature that the children wished to be present in the eBook of the future. As a sort of soft constraint and to provide some guidance to children we established that each color represented a different feature – e.g. green for sounds, blue for videos, red for interactive features, black for navigation controls and hyperlinks, etc.

As DP1 progressed, we asked children to build a paper prototype of the eBook from scratch and we provided them with some raw material. The material included plain text, pictures, markers, sticky notes, glue and scissors. At the end of DP1, to further refine and elaborate the design ideas emerged, in the previous sessions, the prototypes were "disassembled" and each group used the various resulting parts to create new prototypes (see *mixing ideas* technique).

5.4.2 Design Phase 2 (DP2): iPad® Prototyping

Figure 5.3) Children working on iPads® to create eBook prototypes

In DP2 we introduced tablets (i.e. iPads®) as tool to support Cooperative Inquiry. On each tablet we installed a presentation software (i.e. Keynote®) to be used for prototyping. In this phase children worked in pairs sharing one device for each pair. An adult was assigned to provide support with the use of Keynote® and to collaborate with children in the design. Before working on the prototype children were trained on how to use the application, and during the prototyping sessions facilitators were available to re-explain how to use particular features of the application.

Children were asked to translate – and eventually refine – the paper mockups into interactive prototypes by realizing slideshows tat mimicked an eBook. The task to be accomplished was not much different to that of DP1 but the great difference was that this time the content was in digital format and had to be edited by using digital tools – rather than paper and markers.

5.4.3 Paper versus iPad® Prototyping

While we were working on the design of the eBooks prototype we identified a collection of advantages and disadvantages for the two prototyping approaches we adopted. In this section we use the term *paper prototyping* to define a setting where only low-tech materials are used and where the outcome is a non-working paper prototype with a lower degree of fidelity. While with *iPad® prototyping* means that working prototypes are developed on a tablet computer with the aid of a presentation software, and are characterized by a higher degree of fidelity. Below are our findings.

Paper Prototyping Advantages

- **Less resources** – Paper prototyping proved to be less resource-intensive as compared to high-tech prototyping. Children were already accustomed to the materials we employed and there was no need to teach children how to use low-tech tools such as paper and pencils. All this helped to reduce the time needed to setup a co-design session. Moreover, if technological and financial resources are limited, paper prototyping might be the only available option.
- **More creativity** – During paper prototyping children produced a wider range of ideas that were more general in their scope. Children fully unleashed their creativity without being limited by the materials as to what they can actually accomplish – i.e. "blue sky" ideation stage. Children focused more on the "bigger picture" – e.g. "Some pages should have a page-turn button" – rather than on the details of the prototype – e.g. "I want a page-turn button at the lower-right corner of the third page".
- **Better collaboration** – Even though we did not get enough evidence to support the fact that paper prototyping facilitate collaboration, we can say that at least it does not interfere with teamwork, as it is the case for iPad® prototyping – we will discuss this later. Children in our design team discussed and mediated the features to add, they built on each other's ideas and had no problems to share the available low-tech resources.

Paper Prototyping Disadvantages

- **Higher level of abstraction** – Our child design partners were in the age range of 9 to 11 years old. According to Piaget's theory of cognitive

development [19] they were in the concrete operational stage of development. At this age children can solve problems related to concrete entities while they still struggle with abstract thinking and reasoning about hypothetical situations. In our experience the difficulty in dealing with abstract concept has been an issue when we wanted to enrich mockups with features not representable on paper – e.g. hyperlinks, animations, etc.

- **Frustration** – Not being able to realize everything they imagine and struggling with abstract thinking can lead children in a state of frustration. A higher level of frustration means a lower level of engagement in the activity [3], and this is a key issue especially in long-term projects such ours where keeping participants highly motivated along the entire duration of the study is very important. When we did paper prototyping we had to invest a lot of efforts in keeping children motivated and focused for the entire session.
- **Adult interpretation** – We listed creativity among the benefits, but it can be a double-edged sword. Even if creativity has a positive valence in Cooperative Inquiry studies, still not all the ideas children came up with were either pertinent or feasible. Thus a further interpretation of the design ideas to translate them into meaningful user requirements is often needed. This exposes the method to the potential risk of misinterpreting the ideas proposed by children.
- **Lower fidelity** – The low-tech prototypes developed by the design team reflected more general ideas, and this means that these ideas were more vague and not specifically focused on the details of the prototype. Children realized that they were not working on a real digital artifact but rather on its low-fidelity representation and we noticed that this negatively influenced their participation. We acknowledge this could not entirely depend on the prototyping technique used, but also on how good we were in involving them in the design activity. However we noticed a dramatic change in their attitude when we introduced iPads® in the design workflow.

iPad® Prototyping Advantages

- **What you see is what you get** – One of the main advantages we had from the use of tablets and presentation software as prototyping tools was the immediate feedback that designer got from the prototyping tool, a characteristic also known as a What You See Is What You Get (WYSIWYG).

According to Grønbæk [9], tools that support direct manipulation of prototypes and simulation of behavior have shown promise for cooperative prototyping activities. Furthermore the WYSIWYG paradigm reduced the level of abstraction required by the activity.

- **More engagement** – We observed an increase in the children's level of engagement in the design activity. We can exclude that it was due to the novelty effect [2] since we allowed children to familiarize with the device for more than three months before using it as design tool. As a result of increased engagement, children were more focused on the prototyping work, and more attentive to our requests. We could say that the level of children's engagement in the design process increased when the level of abstraction required by the design technique used decreased.
- **Higher fidelity** – IPads® allowed us to design prototypes with a higher degree of fidelity in a very short time – rapid prototyping. In addition to this, designers had more control over the visual appearance of the prototype – i.e. resizing images, formatting text, etc. Children had the opportunity to see how the eBook would look like from an user's perspective and this allowed them to immediately evaluate how their own ideas would look like.
- **Empowering children** – We could observe how the role of children in the design process has been empowered thanks to the use of high-tech tools. On the one hand, the use of iPads® made children feel more competent and this helped us to overcome existing power structures of an intergenerational design team [10]. On the other hand high-tech prototyping reduced the risk of misinterpreting design recommendations elicited through Cooperative Inquiry.

iPad® Prototyping Disadvantages

- **Barrier to collaboration** – After the introduction of tablets we found more difficult to establish a fruitful collaboration among children. Children were overall more engaged in the design process but only few of them accepted to share a single device with other design partners. Based on what we observed we could say that prototyping activity takes more the form of a cooperation – working individually on common goals – than a collaboration – working together on a single shared goal.
- **Resource-intensive** – As opposed to paper prototyping, iPad® prototyping required more resources. First we had to get the hardware and the software needed, and then we had to train children to use the software. If

one wants to develop high-tech prototypes with children cannot avoid an initial investment time and resources. So in the case of tight time constraints or few resources available, high-tech option is hardly feasible.

- **Less creativity** – When we analyzed the prototypes we noticed a lower number of design ideas in prototypes developed on tablets if compared to the paper-based ones. As possible explanation children learned just the basics of Keynote® and this could have limited their creativity. In general, high-tech prototypes elicited fewer design ideas and more in the form of criteria [24], while paper prototypes led children to explore the design space more in terms of options [24][1].

5.5 Outcomes

In one of the preliminary meeting, we asked children to describe the features they would like to see in the eBook of the future, and their advice was quite generic: they suggested to make eBooks less "boring" than traditional books by adding games, interactivity and multimedia content. We did not get more specific recommendation also because this meeting was a sort of icebreaker activity to make children familiar with the working environment and with the other members of the design team, and to prepare them for the forthcoming sessions.

5.5.1 Design Phase 1 (DP1)

At the beginning of DP1 both groups needed time to understand the purpose of the work and asked for guidance from facilitators. The most important outcome of this phase was the proposal of a number of multimedia and interactive features that would turn the paper book that the children physically had in their hands into an eBook. At the end both groups gave a preference to sounds effects that accounted for 28 sticky notes, and interaction – moving, drawing, coloring – with images (24 sticky notes). Videos (5), explicit navigation controls (2), games (1), text-to-speech (1) were less popular. Some children, especially younger ones, struggled to abstract

[1] The two terms *option* and *criterion* come from Sluis et al. [24] redefinition of *QOC-model* – or *Design Rationale Theory* – where options are equivalent to user requirements while criteria are more specific options – i.e. options accompanied by a specification of quantity, location, functionality or value.

the concepts required by this assignment. The mixed-gender group produced fewer ideas if compared to the female-only group – this group also paid particular attention to cover pages. Overall children showed a collaborative attitude, helped each other and elaborated on teammates' ideas. In the mixed-gender group some conflicts were recorded, mainly because boys disliked girls' ideas – and removed sticky-notes – and vice-versa. This allowed us to identify initial design ideas to expand and refine while the work progressed.

The more the work progressed, the better the children worked: conflicts inside the groups decreased and the design ideas were more elaborated. All of the mock-ups children realized had an equal amount of both textual and non-textual – video, sounds, and images – content. Children suggested to add an embedded dictionary for some words and a text-to-speech function to the eBook mockups. This seems to contrast with the low priority given to this feature earlier, but it is important to consider that in the previous task children worked on illustrated books where illustrations were prevailing over the text. Only a group suggested to add game related features in the book, but without explaining in details what they wanted. Overall children were still puzzled on how they could represent a highly interactive feature – like those related to game – in a paper prototype. We agreed on a simple written description of the games but they did not elaborate games and their strategy, they just put signpost notes in for further elaboration. In line with what emerged during previous meetings, all the groups suggested to have interactive images and sound effects in the prototype.

5.5.2 Design Phase 2 (DP2)

During DP2 children were meant to work in pairs, but ended up working almost individually on their devices since they did not want to share their device with others, so the adults assigned to each pair had to switch from collaborating with one children to the other alternatively. As for the prototypes, in this phase children focused more on the interface/structure of the book and on its navigation. Children added navigation buttons, hyperlinks to videos or other pages, and customized text appearance.

The more the work progressed, the more children became proficient using the presentation software. As such, they could focus more on the look and feel of the eBook by adding images, transition effects, and text layout, rather than on the structure of the content (see Figure 5). During the various

sessions, there was little time to engage into more complex design solution – for instance by exploring games or game-book like features where the reader can build his own story plot by making effective choices. Children's skills in using Keynote had improved, but still were on a basic level.

In this phase we noticed how children not only acquired new skills but also gained a better understanding and a more personal insight into the overall goal of designing eBooks for their peers. Each exercise was used to raise their awareness of different features and perspectives of and on eBooks and stimulate their creativity even if the major limit was their inability to abstract. In order to overcome this limitation adults supported them in the elaboration with examples, guidance and one-to-one advice – still giving them suggestions rather than answers.

An interesting aspect we noticed was that all the mockups children realized had a well balanced amount of both textual and non-textual content – e.g. video, sounds, and images. Though relatively simple, the prototypes the children produced still contained lot of indications on how an engaging eBook should be. In the following section we will discuss the guidelines we derived from the most salient ideas emerged during the Cooperative Inquiry study. For each of the guidelines we will describe how they have been implemented in the final prototype and the rationale behind them.

5.6 Design Guidelines for Engaging EBooks

The result of the cooperative inquiry study we described early in this chapter was a set of increasingly elaborated eBook prototypes. Taking inspiration from the ideas reflected in the prototypes, we developed a *"beta"* – i.e. feature complete – version of an *enhanced* eBook based on *"The Little Prince"* novel. The eBook was built using a specific eBook authoring application (i.e. iBooks Author) and existing guidelines on hypertext usability for children [7], eBook production [25], children's interaction with mobile devices [14] and device-specific interaction [1] were taken into account. This phase corresponded to the "build" stage of the typical UX design cycle that we described in Section 1.7. With a co-design approach the "design" and "build" stage are for the most part of their duration overlapping and cannot be separated. Our children design partners actually designed the eBook, what we had to do was simply to put together all their ideas and make sure that the beta version of the enhanced eBook was consistent across its various chapters and there were no bugs or errors in it.

The design guidelines presented in this section have been derived from the ideas that – according to the intergenerational design team – would enable an engaging reading experience. These guidelines do not aim at being prescriptive. Less ambitiously we see them as a source of inspiration for researchers and practitioners for the future design of children's electronic books for leisure reading. For this reason we voluntarily left them quite general in their scope.

I. "It (i.e. the eBook) should not be 'boring": use audiovisual enrichments to allow for different reading paths

Not surprisingly children wanted to have an eBook that is not "boring", and to this end the design team suggested: (a) videos that summarize parts of the text and (b) sound effects linked with words and images. Videos would allow for a non-linear multi-path reading experience – e.g. children could skip some parts of the text or they could recall what they just read – while sound effects can be used by readers both as a diversion from the reading activity or, in alternative, as a support for their imagination [11]. On the whole the idea is that audiovisual elements should be used to supplement and enhance rather than replace text [25] – i.e. to add redundancy to the textual information – thus allowing for different modes of fruition.

II. "It should have a touch of 'Pathos': provide read-aloud narration of the text

Most children have been accustomed to read-aloud narration since a very young age (with parents reading bedtime stories to them) and it seems that its appeal does not cease when children grow older. In fact our young design partners – who were primary school pupils – included this feature in the eBook prototypes they developed.

Reading aloud is nothing new, and audiobooks have been around for years now – long before tablets and eReaders – but technology is contributing to a *digital renaissance* of read-aloud narration [11]. Electronic books allow for more control over the narration playback and for a synchronized combination of visual reading with audio reading. This creates a multi-modal reading experience that, in turn, may result in an intensification of narrative transportation [11] (see also the concept of *flow* in reading [15]). Moreover, previous research showed that the provision of narration may increase text comprehension [8,26] and according to Verhallen & Bus (as cited in [21]):

> *"the temporal contiguity of audio (narration, music) with visual information (illustrations) appears to draw children's visual attention to pictures and print in ways that concretize the text, making it more real for them and more memorable".*

III. "It should be playful": use interactivity to add value to the eBook and make it more playful.

Wilson et al. [25] argued that *"interactivity can increase a reader's sense of engagement with the book and enhance the material's likeability"*. In line with this, the design team suggested to transform the various illustrations in interactive objects so that the reading experience can become more lively and playful. Therefore we included features such as coloring pages (see Figure 5.4) and puzzle games (see Figure 5.5) to the eBook. Children stressed that interactive enhancements should not be implemented just for the sake of interactivity – e.g. trivial touch-and-response animations – but they should add some "value" to the story and enhance the reading experience in a playful way – e.g. a puzzle that has to be solved in order to reveal some hidden text. In addition to increasing engagement, meaningful interactive enhancements may also support reading comprehension – whereas incongruent enhancements may hinder it [26].

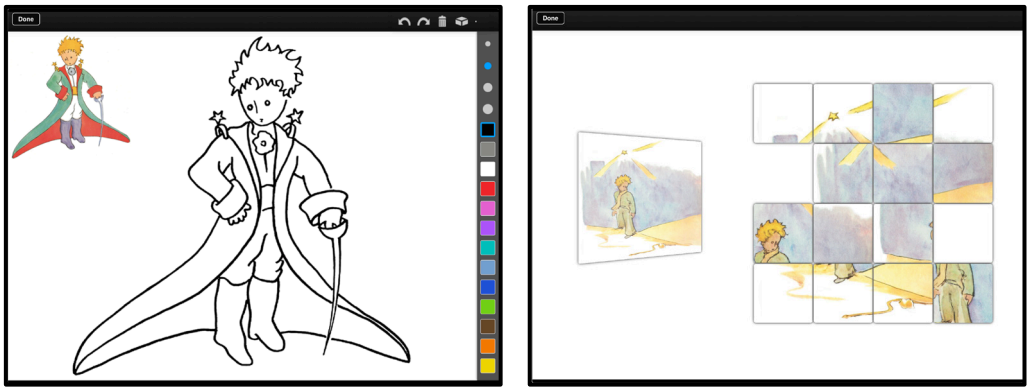

Figure 5.4 – left) An example of a coloring page: by clicking on an outlined illustration children can color it; Figure 5.5 – right) An example of one of the puzzle games we implemented in the enhanced eBook prototype.

IV. "It should not be too difficult to read": provide in-line dictionary definitions and illustrated descriptive cards

In our view text must withstand as the core part of the eBook (see Guideline VI) and many children emphasized the importance of having an eBook that is easy to read (in terms of text comprehension). Writing is (obviously) a writers' duty, yet interaction designers can give their contribution: text can be made interactive with in-line dictionary definitions (see Figure 5.6) or illustrated descriptive cards (see Figure 5.7).

By doing so we enable children to tailor the reading to their skills and this in turn may facilitate *weak readers'* text comprehension or it may allow *strong readers* to expand their reading experience. A good balance between the challenges of a text and a reader's skills is an antecedent of ludic reading [16] and a key condition for *flow* (i.e. intense engagement in a text [15]) to occur. We do not mention here the educational benefits that reading with in-line dictionary entails as they have been already investigated by Korat & Shamir [13].

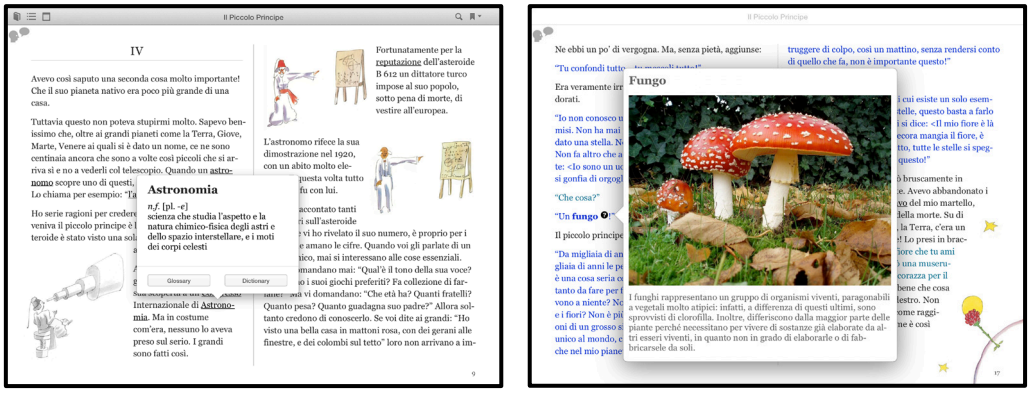

Figure 5.6 – left) An example of an in-line dictionary definition for the word "astronomy"; Figure 5.7 – right) An example of an illustrated descriptive card for the word "mushroom".

V. "It should be colorful": use colors to differentiate the various parts in the text

This might sound as the most trivial and obvious guideline since children's printed books already make an extensive use of colors both for the text and the illustrations. However, surprisingly – in a negative way – colors are seldom used in electronic books and in some cases even illustrations are rendered in black and white. In the *beta* eBook we developed some text was

colored to make it more aesthetically appealing (see Figures 5.8 and 5.9), but also to facilitate readers in recognizing different part of it – such as direct speeches of different characters. A meaningful use of colors may also help readers to identify patterns in the book, thus simplifying the interaction with the text and enhancing readability.

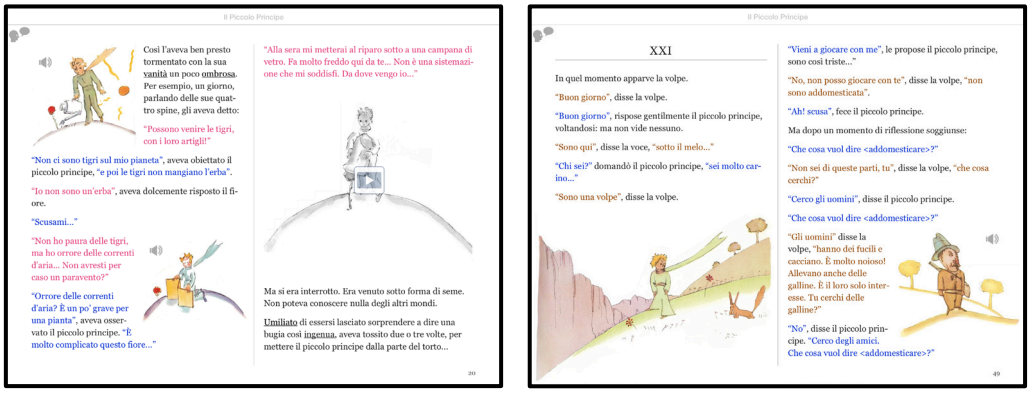

Figure 5.8 and 5.9) Few examples of how colors have been used in the eBook prototype to differentiate the various parts in the text

VI. "It has to remain a book though": use non-textual elements carefully and with moderation

During a brainstorming session – in one of the early meetings – many children asked us whether some of the highly-interactive eBook applications we provided them could have still been considered "books". They were puzzled because those eBooks had little to do with the concept of "book" they had in mind: interactive, multimedia and/or game-like elements were prevailing over the text and the act of reading was confined to an incidental activity. Therefore the design team's suggested that text must withstand as the core component of an eBook. As we already stressed, non-textual elements should enhance, not replace text: they should not be the only source of engagement, they should rather foster readers' engagement with the text.

5.7 Discussion

In this chapter we reported about our experience in the design of eBooks through Cooperative Inquiry, with the children involved with the role of design partners. We described the approach we followed to elicit design ideas and we provided a detailed description of the various techniques we used over a three months period.

Initially, we were rather concerned to use tablets also as prototyping tools, because we thought paper prototyping would have been a faster and less demanding option as well as more familiar to children. However, during the introductory brainstorming and the first phase of the prototyping we noticed that children were reluctant to put their "tech-toy" aside and to work with low-tech tools. Although it was not originally planned, we introduced tablet computers in the prototyping workflow as our children design partners suggested to do so. We then developed different prototypes both with low-tech tools – such as paper and markers – and high-tech tools – iPad® and Keynote®.

It goes without saying that the two approaches have some differences and we already reported about advantages and disadvantages of each approach. Yet we want to stress that children's engagement and empowerment benefit from the use of tablets as prototyping tools, and this observation is in line with what Kam et al. [12] also found. We believe that these two benefits alone would justify the bigger investment in terms of resources that iPad® prototyping requires since our experience suggest that – for children involved in a co-design partnership – more engagement means less frustrations and more empowerment means overcoming existing power structures between adults and children.

In addition to this, we found that our design team expressed more – and more general – ideas when confronted with building paper-based mockups, while in iPad®-based prototypes the ideas were fewer – but more specific. In our case prototyping had an exploratory purpose – i.e. explore new design ideas – but, interestingly enough, previous studies where children informants evaluated low-tech and high-tech prototypes, yielded similar findings [23]. So there seems to be a common pattern on the way high-tech prototyping influence collaborative design studies with children.

On the basis of what we observed paper prototyping should be preferred when the goal of the research is to explore new ideas and stimulate *radical design innovation* [18], while iPad® prototyping should be preferred when the research follows an iterative design approach to generate user requirements

through *incremental innovation* [18] or to improve and refine existing digital artifacts. This said, we should also consider that designers have different needs when trying to get a new idea than when expanding or evaluating the idea at a later phase, so the whole range of needs implied by this progression must be addressed [22]. This means that both paper-based and tablet-based prototyping techniques should be used at different phases of the same design project: the first technique works better at the beginning when designers freely explore options and trigger their imagination in creative setting, the second is better when ideas need to be refined and tested in a realistic setting.

Based on the outcomes of the design stage, we proposed some recommendations for designing better and more engaging eBooks for children. These recommendations were informed by the ideas of an intergenerational design team. Cooperative Inquiry proved to be an effective method for our purposes: the long-term partnership with children co-designers allowed us to explore many ideas and, consequently, to condensate the most salient ones into a set of six guidelines. In general, some of these guidelines seem to suggest that the eBook should be designed to be flexible enough and to allow children to tailor the reading experience on their persona in order to reach a balance between the challenges of the reading activity and their skills. The use of interactive and multimedia elements to enrich the reading experience is another important aspect in a context of leisure reading, but designers should exercise caution when implementing these features. This because the story told by the text is, or should be, the core of the book and the main source of children's engagement with it: therefore any design solution or enhancement should contribute in this sense.

5.7.1 Limitations

The eBook prototypes were developed using a presentation software installed on a tablet computer. We believe some features of the device – such as portability and multi-touch interface – could have helped to switch from paper-based to tablet-based prototyping, however we did not investigate whether and how the above-mentioned characteristics could make a difference if compared to high-tech prototyping done with different platforms.

Also, our work was focused specifically on the development of eBook prototypes. So it still has to be proven whether our considerations can be extended to the design of other even more complex systems that require a higher level of abstraction. In the same line, we used Cooperative Inquiry as design method and its related techniques like Sticky-notes and Mixing ideas. Even if we motivated our choice, this does not exclude that other methods and techniques that we did not have the time to test can be applied for the design of children's eBook.

For time and budget constraints we have not been able to develop different prototypes based on different stories. Even though we worked on a widely appreciated novel such as *"The Little Prince"*, this is a limitation in the sense that proper book selection is an antecedent of leisure reading [16] and also the influence that the plot of the story has on the reading experience cannot be neglected.

5.8 Summary of the Chapter

This chapter described the work we conducted at a children's library to design an engaging eBook for children. The study was characterized by two phases, the first one where we elicited design ideas through paper prototyping, the second one where we introduced tablet computers as prototyping tools. We saw that design ideas elicited through paper-based prototyping were more general in their scope while prototyping on tablets allowed us to obtain more detailed feedback and specific user requirements. Our experience suggests that paper prototyping would be better suited for radical innovation, when the goal is to generate new ideas; while iPad® prototyping would be a better choice to support incremental innovation, when the goal is to iterative develop, enhance and evaluate a digital artifact – or to refine design features emerged from early prototyping phases.

The use of the Cooperative Inquiry method allowed us to explore various design ideas together with a group of 9 to 11 years old design partners. Starting from these ideas, we developed a final eBook prototype which included the most recurrent ideas emerged during the design phase. Based on the ideas implemented in the prototype we elaborated a shortlist of recommendations:

1. "It (i.e. the eBook) should not be 'boring": use audiovisual enrichments to allow for different reading paths;
2. "It should have a touch of 'Pathos': provide read-aloud narration of the text;
3. "It should be playful": use interactivity to add value to the eBook and make it more playful;
4. "It should not be too difficult to read": provide in-line dictionary definitions and illustrated descriptive cards;
5. "It should be colorful": use colors to differentiate the various parts in the text;
6. "It has to remain a book though": use non-textual elements carefully and with moderation.

Our hope is that these guidelines will inspire researchers and practitioners to create better and more engaging eBooks. In the next chapter we will describe how we evaluated the efficacy of these guidelines in fostering user engagement.

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Chapter 6

Evaluating the Reading Experience

To verify if the eBook we designed together with children had a positive impact on the reading engagement we conducted an evaluation study aimed at understanding whether the *"enhanced"* eBook prototype we developed would have provide a better reading experience compared to the *"basic"* version of the same eBook. Here with enhanced eBook we identify an eBook enriched with multimedia and interactive elements while with basic eBook we mean an artifact that is a sort of digital facsimiles of a printed book (like most eBooks on the market)[1]. However the word "enhanced" should not be misunderstood: our view is that an eBook has to remain a book, thus the textual content must always be predominant.
Having clarified this point, the question we tried to address in this phase of the project was: does an eBook developed following our guidelines provide a more engaging eReading experience? To answer this question we first developed a theoretical framework – which is described in Chapter 3 – based on the concept of flow. Building on this framework we developed an innovative approach – based on the Experience Sampling Method (ESM) – for the evaluation of the eReading experience. In this chapter we describe this approach and discuss the results we obtained.

[1] See the definition of eBook in Section 1.6

6.1 Methodological Approach

For this study we chose a *between-subject* experimental design: one group of participants (*experimental group*) read an enhanced eBook while the other acted as (a sort of) *control group*: this group read the basic version of the same eBook (i.e. just text and images). The aim of the evaluation was to assess participant's "flow" in the eReading experience and then to compare the two groups to see which one featured a higher level of flow and, thus, to understand which book provided a better eReading experience. Our hypothesis was that participants in the experimental group would have had a better eReading experience.

In order to choose the proper evaluation method, we kept into account some peculiar aspects of the reading experience:

- *long duration*: for readers – especially younger ones – it usually takes from a few days to a few weeks to read an entire book;
- *fragmentation*: a book is almost never read from the beginning to the end at once, but reading experience is often fragmented over many sessions;
- *sequentiality and cumulativity*: each session usually starts from the point where the previous one ended, cumulating with all the previous ones in a sequential way;

These aspects guided our decision on the UX evaluation method to use. First of all, we had to consider that with the inherent portability of eBook readers, smartphones and tablets, eBooks may be read in changing contexts and unpredictable situations. Many researchers agree that UX is context dependent [1,15], thus traditional lab-based evaluation techniques tend to be inadequate as they omit this critical factor. For this reason, and to preserve a natural context of leisure reading, the evaluation was carried out on the field As we have seen in Chapter 2, in Children-Computer Interaction research three main approaches are used to investigate the user experience on the field: naturalistic observations, surveys and diaries.

In our case, observation methods would have been practically impossible to deploy due to the peculiarities of eReading experience we mentioned above: we should have followed each of the thirty-two participants throughout the day in a variety of places (e.g. at school, at home, at playgrounds, etc.) waiting for him/her to interact with the eBook. This was simply not feasible. As for survey methods, we did not choose them because De Leeuw et al. [17] strongly advise against the use of recall surveys / retrospective questions with children in middle childhood:

> *"During middle childhood (7-12) memory and especially storage and retrieval of information are still developing […] A general advice is to avoid retrospective questions as far as possible, especially when asking for non-standard events and details […] young children (early middle childhood) have more difficulties to distinguish between imagined events and those actually perceived".* [17].

At the same time to overcome difficulties with questions that require complex memory processes, and cannot be answered from memory directly they suggest to use diary-based methods [17]. Their assertion finds support in other studies, one of which also involved the investigation of leisure reading:

> *"The diary method minimally appeals to cognitive processes and memory, and [uses] the 'here and now' type of question, which is especially appropriate for children (Amato & Ochiltree, 1989) […] Otter (1993) showed that the use of the diary method with children, aged 9 years, to measure leisure-time reading yield good response quality, produce reliable and valid data responses. Even when the concepts of interest produce questions that burden children's memory, the use of diary method is by far superior compared to self-administered paper and pencil questionnaires (Otter, 1993)".* [17].

For all these reasons we decided to use a diary-like method namely, and our choice fell on the *Experience Sampling Method (ESM)*. We already exhaustively described the method in Section 2.3.1, but for more information the reader can refer to Intille et al. [11] for the rationale of using the ESM in HCI research or to Moneta [22] for the main strengths and limitations of ESM. As we wrote in Section 2.3.1, one of the main limitations of the ESM is that it interrupts the experience being assessed. In an attempt to deal with this limitation – which however does not affect the efficacy and validity of the method [3,8] – we looked for a flow questionnaire that children can complete in less than 1-2 minutes. For this study, the questionnaire we used in combination with the ESM is an adapted and translated version (see Figure 6.3) of the *Flow Short Scale (Flow-Kurz-Skala; FKS)* [4]. The FKS is a Likert scale consisting of 10 items through which respondents can evaluate their experience in relation to the components of flow (see Figure 6.1). The FKS has already been validated and successfully used to evaluate UX with computer games [4,28] and the web [18]. With the help of teachers and educators we

adapted the FKS to the cognitive skills of primary school children by following De Leuww et al. guidelines [17] and by taking inspiration from Read & MacFarlane's *Fun Toolkit* [27]. Accordingly we rephrased some of the items to make them easier to understand for the children and we used 5-points pictorial Likert items instead of the 7-points Likert items of the original FKS.

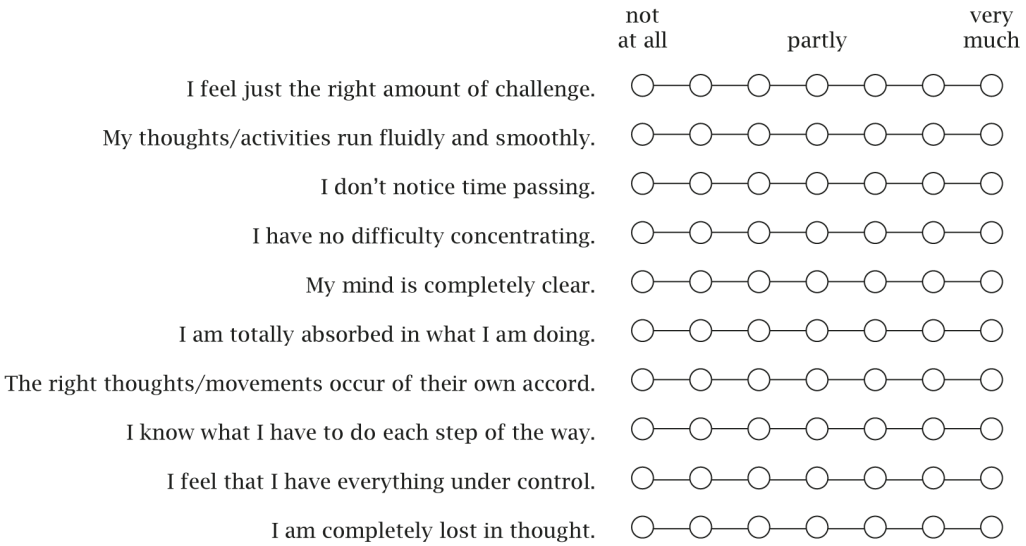

Figure 6.1) The original Flow Short Scale (from Engeser and Rheinberg [4])

6.2 Participants and Setting

Participants were volunteered from a population of primary/lower-secondary school pupils aged between 7 and 12 (*Md = 9*) from the Swiss canton of Ticino and the Italian region of Lombardy (all native Italian speakers). Even though the 7 to 12 age range might appear as relatively broad, it corresponds to the *concrete operational stage* of cognitive development [25]. De Leeuw et al. [17] well summarize the cognitive skills of children in this stage:

> *"In the first period (roughly 7 to 10) short term memory matures, but information processing is still twice as slow as in adulthood. Children learn to recognize the viewpoint of others and at the same time become more sensitive for disapproval. In the second period (roughly 10 to 12) memory is full-grown and processing speed increases. Basic reading and writing skills are*

> *acquired. Children have developed a social identity, and can put themselves in the other's place. Making friends becomes very important and they actively seek approval".*

For the purpose of this study what is most relevant is that basic reading and writing skills are acquired.

Thirty-two children (20 females, 12 males) were recruited using a combination of mailing lists, ads in public libraries/schools and snowball sampling to achieve a good mix in age and gender. Participation in the study was voluntary – upon active parental consent – and participants were randomly assigned to either the experimental or the control group. Below we report a summarized profile of the sample that took part in the experiment:

- eighteen children were regular users of tablets while six had never used them before;
- fourteen children could be regarded as strong readers (i.e. they had read more than 12 books in the last year) while six as weak readers (i.e. they had read less than 3 books in the last year);
- eight children had previously read the novel used for the experiment – nineteen if we include those who partially read it;
- twenty-eight children had never read an eBook before.

Having both regular and first-time users of tablets, and both children who had previously read or not the novel, allowed us to check for undesired effects due to novelty of the device or personal preferences, likes, or dislikes related to the novel – regardless of the eBook format.

The use of the experience sampling method allowed us to carry out the study *in situ* (i.e. wherever each participant read the book and answered the questionnaire), initial and follow-up interviews took place at our research facility when we met the participants to explain them the study and to collect the tablets.

6.3 Materials

We provided each participant with a tablet – on which we installed the eBook and the software to be used for the evaluation. Participants could have kept the device for all the time needed to read the novel – usually 1 or 2 weeks. In that period they were allowed to bring the tablet with them whenever and wherever they wanted. For this study we employed iPads® 2 tablets. Even

though they are not eBook readers in the strictest sense, working with tablets allowed us for more flexibility and a better support for interactive and multimedia content. On each tablet we installed the iOS 6.1.3 operating system and the iBooks 3.1 app.

Both the basic and the enhanced eBooks have been developed using a specific eBook authoring application (i.e. iBooks Author) and are based on *"The Little Prince"* novel. We chose this novel following the advice of teachers and librarians because it is one of the few classic readings that is suitable for a wide range of ages – including 7 to 12 years old children. The basic eBook we developed was a digital facsimile of the print version of the novel – same text and same illustrations (see Figure 6.2). The enhanced eBook was a book enriched with video, audio, interactive and extra features following the advice of the intergenerational design team – see the previous chapter for a detailed description of the design process and of the characteristics of the eBook.

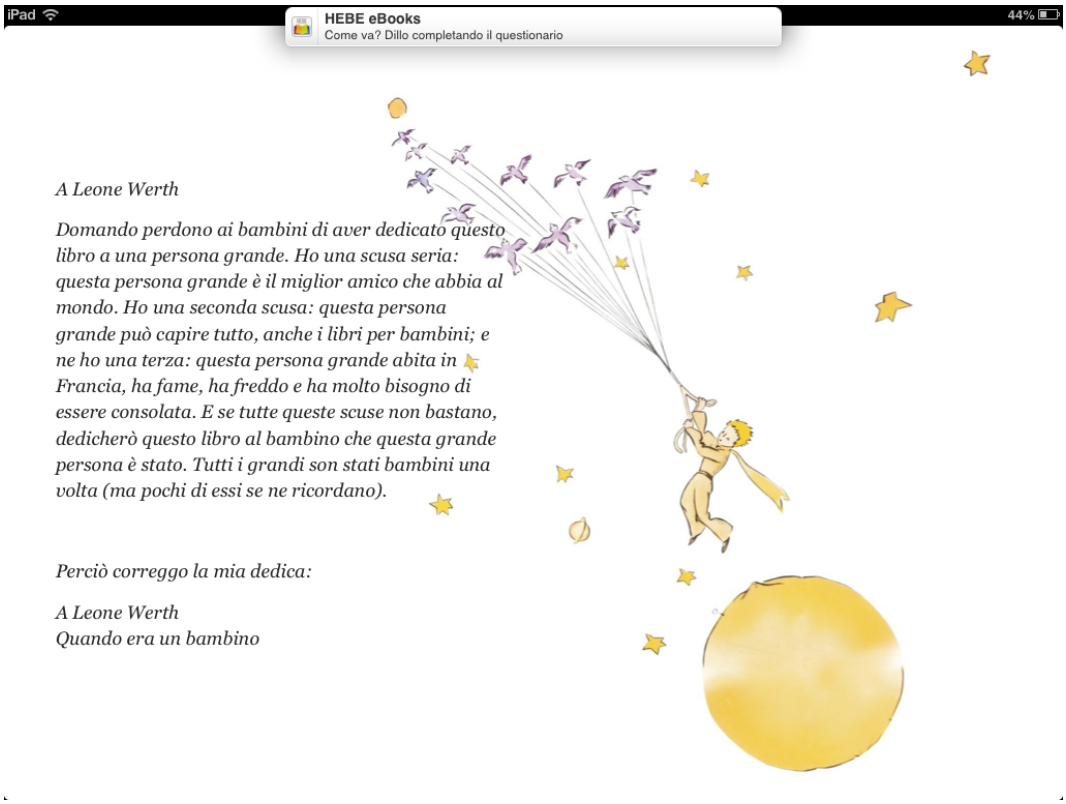

Figure 6.2) A screenshot of the eBook with the ESM notification banner at the top of the screen

6.3.1 Experience Sampling Application

To evaluate the eReading experience we developed an *ad-hoc ESM iOS app(lication)* that runs on the tablet participants used to read the eBook. As stated by De Leeuw et al. [17]:

> *"[electronic diaries] produce good data quality (Kalfs, 1993). Van Hattum and de Leeuw showed that children are very good in computer-assisted self- interviews (CASI); even children from the age of 8 year successfully completed the questionnaire and enjoyed the process (Van Hattum & de Leeuw, 1999). The use of electronic diaries can motivate children because it gears to their experiences and minimize the burden of memory."*

The ESM app we developed works in the following way. When participants are reading the eBook some notifications are scheduled at pseudo-random intervals set by the experimenter – following a pilot study we set the range of variation from 15 to 25 minutes. At the scheduled time each notification is shown on the device in the form of a banner at the top of the screen (see Figure 6.2) followed by a sound. When the user answers a notification by tapping on it, an instance of the adapted FKS questionnaire is presented on the screen (see Figure 6.3). Once the user fills out and submits the questionnaire, the screen reverts back to the eBook page the user was reading. For every questionnaire submitted by the user, the application records the answers to each FKS Likert item in the form of a numerical value ranging from 1 to 5.

The application can also collect additional data through video recording and automatic logging. With video recording users have the opportunity to enrich information provided through the questionnaire with their personal thoughts about the experience – a sort of "additional comments" field. As for automatic logging, the device registers the current time, its geographic coordinates and its orientation in the space every time a notification is answered.

In order to provide a usable data collection instrument and to reduce its interference with the activity being assessed, in addition to what recommended in [6] and [13], we developed the ESM application with the following guidelines in mind:

- notifications to fill out the questionnaire should not be disruptive – i.e. the alert should be a subtle stimulus in the periphery of the attention;

- users should be allowed to answer to a notification whenever they prefer – yet within 20 min from when the notification was triggered;
- the time needed to fill out the questionnaire should be minimized to reduce activity interruption.

The application was written in the Objective-C programming language and developed by using the Xcode IDE (Integrated Development Environment). The application's source code is reported in the Appendix A.

Figure 6.3) A screenshot of the ESM application showing the adapted FKS questionnaire

6.4 Procedure

Prior to running the *in situ* evaluation we piloted the ESM app and the adapted FKS questionnaire on four children from the same population of the sample. This allowed us to set the proper interval between each notification, correct some small bugs in the software and review some of the items of the FSK to make them clearer. Before the study began we defined a procedural

framework that we used throughout the study and that is reported in this section.

Following a similar approach to that of other researchers (see for instance [2,10,19,21]), we coupled the diary study with initial and follow-up semi-structured interviews. The initial interview aimed at profiling participants while the follow-up interview aimed at gathering additional qualitative data on the eReading experience. Interviews lasted approximately 30 minutes but the interview format allowed participants to introduce new issues – which they regarded as important – to the discussion and thus to extend their duration.

When we first met the participants – each participant individually and accompanied by one parent – we explained to them and their parents the purpose of our study and we emphasized that it was not a test on their skills or a homework assignment. We also told them to be as objective as possible in answering the questionnaire, that there was not right or wrong answer and that they did not have to please us. We stressed that their participation was on a voluntary basis and that they could drop out from the experiment whenever they wanted. After this preamble we asked the parents to sign the consent to take part in the study, the privacy policy (as requested by our internal code of ethics when conducting user studies with children) and the free loan agreement for the tablets.

We then gave the tablets to the children and we showed them all the features of the ESM application and how to use it. We read with them all the items of the FKS and we carefully checked that they understood the meaning of every single item. After that, we conducted the initial interview where we asked the children:

- Do you like reading?
- How many books do you usually read in a year?
- Where do you usually read?
- Did you already read this novel?
- Do you use a tablet at home and if yes how often?
- Did you ever read an eBook?
- What do you expect from the eBook?

Experience sampling was the core part of the study. As we wrote children kept the tablet until they finished to read the book and meanwhile they had to fill out and submit FKS questionnaires whenever they received a notification. Once they finished to read the book they had to attend a post-

study meeting to return the tablet and to take part in the follow-up interview. The following questions were asked after the study:

- Did you read the entire eBook?
- How long did it take you to read it?
- How would you rate the eBook (poor, fair, good, very good, excellent)?
- Where did you read the eBook?
- What did you like the most?
- What did you like the less?
- What would you change/add in the eBook?
- Would you like to read a similar eBook?
- Would you suggest this book to your friends or classmates?
- Do you have any additional comments or thoughts?

Finally we thanked the children – and their parents – for their participation and we asked if they wanted us to keep them informed on the results of the study. In the next section we describe how we analyzed both quantitative and qualitative data and the result we obtained.

6.5 Outcomes

Following the recommendation of Law [16] to investigate UX using a *mixed-method* approach, we collected and analyzed data both quantitatively and qualitatively. Maxwell [20] suggests that quantitative research should address *"whether"* and *"to what extent"* questions while qualitative research *"how"* and *"why"* questions. Accordingly, in this study quantitative analysis served to verify *whether* participants in the experimental group had a better (or worse) eReading experience compared to participants in the control group; while qualitative analysis served to understand *why* the UX with the enhanced eBook was better (or worse) – and thus to complement and supplement quantitative findings.

6.5.1 Quantitative Analysis

Starting from the data we collected through the ESM app[2] we computed a *flow score*. The flow score is simply the sum of the answers to the ten items

[2] See Section 6.3.1 for details on the app and Appendix B for the raw data we collected.

of the FKS questionnaire. As each answer can assume a value that can range from 1 to 5, the flow score can range from a minimum of 10 to a maximum of 50; a higher score indicates a higher level of flow. Table 6.1 shows each participant's median flow score (and the median absolute deviation of the flow scores) together with age, sex, number of completed questionnaires and response rate (i.e. the number of completed questionnaires divided by the number of total notifications expressed as a percentage).

	Experimental Group															
Participant ID	P02	P04	P05	P09	P11	P15	P18	P19	P20	P21	P22	P26	P27	P30	P31	P32
Age	7	7	10	7	12	10	10	9	10	12	8	8	8	10	10	9
Sex	M	M	M	F	F	F	F	F	F	F	M	F	F	F	M	F
Nº of completed questionnaires	10	15	8	9	16	8	18	5	5	4	8	28	7	4	15	18
Response rate	30%	23%	21%	23%	38%	12%	26%	10%	16%	17%	40%	40%	44%	9%	33%	55%
Median flow score	47	50	48.5	50	50	46	45	46	43	45.5	49.5	48	48	46.5	48	49
Median absolute deviation	0.5	0	1.5	0	0	1	1.5	1	1	1	0.5	1	1	1	1	0.5

	Control Group												Excluded			
Participant ID	P01	P06	P07	P12	P13	P14	P16	P17	P23	P24	P28	P29	P03	P08	P10	P25
Age	11	8	10	9	11	11	10	12	8	8	7	12	10	8	9	8
Sex	F	F	M	M	F	M	F	F	F	M	M	F	F	F	M	F
Nº of completed questionnaires	18	4	9	17	14	5	5	10	7	20	8	7	2	27	1	0
Response rate	42%	18%	26%	22%	18%	10%	8%	22%	11%	20%	12%	35%	4%	32%	2%	0%
Median flow score	37	34	48	35	43.5	47	41	34	44	29	41	39	47.5	50	42	-
Median absolute deviation	5	2	2	4	2	0	0	1	2	1.5	1	1	0.5	0	-	-

Table 6.1) Age, sex, number of completed questionnaires, response rate, median flow score and median absolute deviation for each participant.

Eighteen children were assigned to the experimental group (see the upper part of Table 6.1) and fourteen to the control group (see the lower part of Table 6.1) randomly. However four children (in gray in Table 6.1) were excluded from the comparison: P03, P10 and P25 due to a very low response rate – lower than 5% – and P08 because her pattern of responses showed a very strong *acquiescence bias* (i.e. the tendency to answer positively) [27]. As a side note we point out that, of the four excluded participants, two were from the experimental group (P03, P08) and two were from the control group (P10, P25): including them in the analysis would have added even more significance to the result – and increased the effect size – but we decided to take a conservative approach during the data-cleaning phase.

We followed a conservative approach also in organizing the data to allow the use of traditional inferential tests. To reduce the probability of Type I errors – and to avoid the problems of inflated N and unequal weighting – we employed *subject-level analysis*. This involves computing appropriate aggregate scores for each individual and analyzing these scores using the person as unit of analysis [14]. Since the data type gathered through Likert scales is ordinal, we used the median to compute the aggregate scores

(represented by horizontal dashes in Figure 6.4). For this and other reasons – like the distribution-free nature of the data and the unequal and relatively small size of the groups – we used non-parametric inferential tests to check for differences between the two groups of participants – as advocated by Kaptein et al. [12].

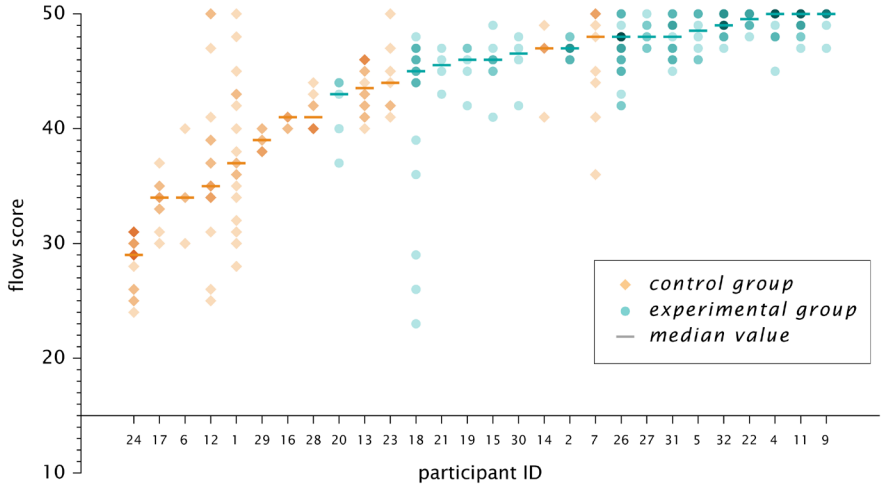

Figure 6.4) Dot plot of the flow scores grouped by participant and sorted according to participant's median flow score. Aquamarine circles represent scores of the experimental group, orange diamonds represent scores of the control group. The darker is the mark, the higher is the number of occurrences of that particular value for the participant.

The dot plot graph in Figure 6.4 shows all the flow scores we obtained during the experiment. Scores are grouped by participant, and participants are sorted according to their median flow score. Aquamarine circles represent the scores of the participants in the experimental group while orange diamonds represent the scores of the participants in the control group. A darker mark indicates a higher number of occurrences of that particular value for the participant.

A Mann-Whitney-Wilcoxon test was performed on the median flow scores to check whether there was a difference in the level of flow, between the experimental and the control group. The test showed that the flow scores of children in the experimental group (Md = 48.00) were significantly higher than the flow scores of children in the control group (Md = 40.00), U = 17.00, z = –3.68, $p < 0.05$, r = –0.69 (see Figure 6.5).

To identify potential *confounding factors*, participants were also grouped by: (A) regular, first-time and occasional user of tablets; (B) children who had

or had not already read the novel (or who had partially read it); (C) weak, strong or average readers. We then compared the so obtained groups using a Kruskall-Wallis test, but in none of the cases significant differences were found: (A) $H(2) = 4.43$, $p > 0.05$; (B) $H(2) = 1.15$, $p > 0.05$; (C) $H(2) = 1.27$, $p > 0.05$. Also when we grouped participants according to age (D) or gender (E) inferential tests did not show significant differences between groups: (D) $H(2) = 1.25$, $p > 0.05$; (E) $U = 65.5$, $z = -1.32$, $p > 0.05$. We eventually computed a Pearson correlation coefficient to check for the degree of linear dependence between participants' response rates and average flow scores, but the two variables did not show to correlate significantly: $r(28) = 0.25$, $p > 0.05$.

All the statistic tests were performed using the SPSS Statistics software, the full output of the above mentioned tests is reported in Appendix C.

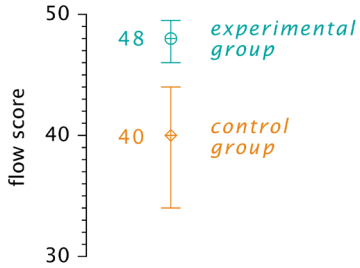

Figure 6.5) Median flow scores of the experimental group and the control group. Whiskers represent approximate 95% confidence interval for the estimated population's median (actual coverage is 97.9% for the experimental group and 96.1% for the control group)

6.5.2 Qualitative Analysis

We pooled and analyzed data obtained through initial and follow-up interviews following a summative content analysis approach [9]. We generated codes by looking at the frequency and relevance of the issues raised by the children – i.e. those issues that occurred frequently or that were emphasized by the children. Two researchers independently hand-coded the data and disagreements were resolved by discussion in order to reach a consensus. As we did for the quantitative analysis we divided the children into the two groups but in this case none of the children was excluded. Here below we report the results of the analysis in terms of *quasi-statistics* [20].

In the initial interview we inquired children about their expectations regarding the eBook. Half of the children did not know what to answer;

among those who answered many said to be expecting a *"better/different"* experience in comparison to reading print books; we asked them to try to be more specific but they struggled to provide a more articulated answer to this prospective question.

In the follow-up interview we asked participants about whether they finished or not to read the novel and whether they wanted to read another similar eBook and would suggest the eBook to someone else. In the experimental group (enhanced eBook) all the participants reported to have read the novel until the end, all of them wanted to read another similar eBook and all of them would have suggested the eBook to others. In the control group (basic eBook) four participants – out of fourteen – did not finish to read the novel (and none of them had read the novel before), four did not want to read another similar eBook and less than one third of the children would have suggested the eBook to others. We also asked to rate the eBook as poor, fair, good, very good, excellent: in the experimental group the eBook was rated as "excellent" by all the participants but two – who rated it as "very good"; in the control group the ratings were more distributed: we had three "excellent", six "very good", three "good", one "fair" and one "poor" ratings.

The last question we asked was about likes, dislikes and suggested improvements. As for the enhanced eBook read-aloud narration was by far the most appreciated feature – mentioned by the 50% of the participants – followed at some distance by puzzle games, videos and interactive images (in this order). Two participants did not like interactive images while others did not like sound effects or videos. Two children reported to have found inline dictionary definitions too complex, two other children suggested to improve the eBook by adding more dictionary definitions and descriptive cards while three children suggested to make dictionary definitions more child-friendly. As for the basic eBook: two participants lamented to have suffered eyestrain after prolonged use of the device, one child complained about the weight of the tablet while another evidenced the lack of clear indications about reader's progress through the book; three participants suggested, respectively, to add read-aloud narration, games and more images.

Very informative data was obtained from the unstructured phase of the interview, where the participants had the opportunity to contribute with additional comments and thoughts. Four participants from the experimental group told us that they had the print version of the novel at home but they never started or finished to read it; three participants told us that they read some parts of the book together with their parents; three participants told us

(one more time) that they really enjoyed read-aloud narration, two participants said that after having read the book they went back to replay videos and read-aloud narration; four children said that the interactive and multimedia elements made the eBook *"less boring"* than print books. For what concerns the control group, five participants spontaneously told us that they still prefer reading print books while two participants expressed their concern to use the tablet other than at home since the device could get broken or stolen.

Few children gave us some feedback also on the evaluation method used in this diary study: two of them found the ESM notifications bothersome while one (P10, who was excluded from the quantitative analysis) reported to have had difficulties in understanding some items of the questionnaire.

Overall only four participants recorded some videos (twelve videos in total) through the ESM app, and those videos did not add much to the information we obtained with the interviews: most of them contained children's enthusiastic comments about the enhanced eBook.

In the next session we discuss the implications of our findings.

6.6 Discussion

The decision to use the Experience Sampling Method proven to be a right choice as it allowed us to evaluate the eReading experience on the field and to preserve the natural context of use – a critical factor when evaluating user experience – and to get a better insight on eBooks and leisure reading. The Experience Sampling Method well adapted to the long-term, fragmented and sequential/cumulative nature of reading experience and – in combination with an adapted version of the Flow Short Scale – it allowed us to collect meaningful data about children's UX with the eBooks.

Despite the relatively small sample size and the rather low response rate, we collected enough data for hypothesis testing. In fact, the comparison of the aggregated (i.e. median) flow scores showed that children's experience with the enhanced eBook was significantly ($p < 0.05$) better than children's experience with the basic eBook. Not only the result was significant but also the effect size was large ($|r| > 0.5$). This gives even more relevance to the result if we consider the implicit acquiescence response bias that is common to observe with young respondents [27] . When we grouped the data according to other factors – such as children's age, gender, use of the device, reading habits, etc. – in none of the cases we obtained a significant result

from the comparisons, in other words we did not find evidence that these factors have a direct influence on the observed variable (level of flow). We also tested whether in the present experiment a low response rate could have been an indicator of a higher level of flow (i.e. strong negative correlation), but the Pearson's *r* did not indicated any significant correlation between these two variables.

In the light of the above we confirmed the hypothesis that participants in the experimental group would have had a better eReading experience. This could mean that, in a context of reading for pleasure – or at least in the context of this study –an eBook designed following our guidelines may have a positive effect on the leisure eReading experience and it may contribute to increase the level of flow of children.

Results obtained from quantitative analysis were then complemented with qualitative findings: this allowed us, among other things, to understand why the UX with the enhanced eBook was better. As revealed by the initial interview, many children expected a better/different experience in comparison to reading print books. If we interpret this in the light of the fact that the basic eBook was a digital facsimile of the print book, we have a first insight on why participants in the control group reported a lower level of flow: the eBook simply failed to meet their expectations. After all what is the benefit in terms of UX of having eBooks that are nothing more than digital facsimiles of print book? As a matter of fact, most of the children who read the basic eBook spontaneously told us that they still prefer print books and this is reflected by the fact that almost one third of the participants in the control group did not finish to read the novel. By contrast, all children in the experimental group finished to read the eBook and showed a higher desire to repeat the activity (see also the concept of *endurability* [26]). This could have implications that go beyond the momentary or hedonic aspects: eBooks with a better reading experience might motivate children – in particular reluctant readers, as suggested by Maynard [21] – to read more, with all the benefits that this entails in terms of literacy and educational attainments (see Section 1.4). In support of this speculation we emphasize that some participants in the experimental group who did not (finish to) read the print version of the novel despite owning a copy, did read the electronic enhanced version from the beginning to the end. Another participant from the experimental group (P03) told us that she did not like the story plot but still she read the eBook until the end because she liked to interact with it while reading the text. Quite the opposite happened with P25 who was assigned to the control

group: she dropped out of the study after reading a few pages because – as she told us in the follow-up interview – she *"did not like the book at all"*.

The results showed that read-aloud narration was by far the most appreciated feature among the ones we used to enhance the electronic book. P19 said that with read-aloud it was *"quite like being at the theater"* meaning that the experience was more encompassing, P32 reported that *"reading the book with a narrative voice in the background makes you more immersed into the story"*. We stress the fact that read-aloud narration is nothing new – audiobooks have been around for years now – but the innovation is in the way this feature can be implemented in an eBook. In the eBook we developed for this study the audio is synchronized with the text page by page and children could control the audio playback without having to switch to another application or device – as in the case of CD audiobooks – and thus without diverting their attention from the text page.

We argue that the seamless combination of visual reading with audio reading has the potential to make eReading a richer and more engaging experience. Indeed this combination enables a multi-modal reading experience allowing the readers to perceive the text through both vision and hearing, which requires them to devote more attentional resources to the activity of reading. As we wrote in Chapter 3, this concept of *attention saturation* is central to flow theory; hence we can understand why read-aloud narration was so appreciated by the readers and why it may result in an intensification of narrative transportation [7], namely in a higher likelihood of "getting lost in a book" – i.e. entering in a flow state.

We could extend the argument of flow and attention saturation to other eBook enhancements provided that they give a meaningful contribution to the text; otherwise they could distract the reader and compromise the eReading experience. This is reflected by the fact that not all the children in the experimental group liked the video, audio and interactive enrichments we added to the eBook.

It is also important that the various enhancements aim at providing an adequate level of challenge (also read as "opportunities for action" [23]) that meets the skills of the reader. For instance few children found the dictionary definitions too complex and suggested to make them more child-friendly – later we realized that these definitions should have been taken from a children's dictionary rather than from a common dictionary as we did. This is just one example of the importance of a good balance between the challenges of the activity and the person's skills – as flow theory suggests.

6.6.1 Limitations

The sample we used in the evaluation was relatively small in size – still in line with the sample size of many HCI studies. Even though inferential statistics provided significant results – with a large effect size – the way we sampled the participants might limit the population to the specific context where the study was conducted. Therefore we suggest caution in generalizing our results. Moreover, the fact that we did not find significant differences when we compared children grouped according to other factors – use of tablets, reading frequency, previous exposure to the novel, age or gender – may be due to the small size of the sample we used; therefore we cannot exclude that these factors have an influence on the level of flow.

Being the first time that a combination of ESM and FKS is used with children, more work is needed to test their effectiveness when used with this specific population. For instance, our study confirmed that attrition is one of the main disadvantages of ESM (the average response rate in the present study was around 22%) and that acquiescence bias is often a problem when working with children. Research has to look for solutions for limiting – if not eliminating – these issues. As for FKS, we had to adapt and translate it to make it understandable for our participants. Given that it was applied and validated in a broad variety of contexts [18] we assumed its validity also in the context of this study, yet it may be useful to test for this assumption. Also, the self-video-recording feature we implemented in the ESM app did not produce the outcome we expected since very few children used it. Even if we could speculate on the reasons behind this (e.g. intimacy of the reading experience), it is clear that more work is needed.

Because of time and budget constraint we developed and evaluated only a couple of eBook prototypes based on a single novel. As the book choice and the plot of the novel inevitably have an influence on the reading experience [24] this can be another limitation to our study.

6.7 Summary of the Chapter

In this chapter we described how we evaluated 7 to 12 years old children eReading experience in a context of leisure reading by means of the Experience Sampling Method and an adapted version of the Flow Short Scale. Our goal was to investigate children's eReading experience with eBooks, and in particular we wanted to understand whether enhanced eBooks would have

provided a better reading experience than basic eBooks. Our research question was: do multimedia and interactive enrichments have a positive effect on the leisure eReading experience or they are just purposeless embellishments? We collected data on the reading experience of two groups of children: one group read an enhanced eBook while the other read a basic version of the same eBook. We then compared these two groups. The results showed that the level of flow was higher in the first case and thus we concluded that the enhanced eBook provided a better eReading experience. Through qualitative analysis we realized that the basic eBook failed to meet children's expectations about the experience while the enhanced eBook supported endurability and flow. These findings indicate that children's eReading experience would greatly benefit from multimedia and interactive enhancements (read-aloud narration in particular) provided that they give a meaningful contribution to the storyline.

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Chapter 7

Conclusions

The impetus for the research herein described was to explore a relatively new phenomenon, namely primary school children's interaction with eBooks in a context of leisure reading. As we wrote in the introduction (Chapter 1) the goal of the *Highly Engaging eBook Experiences (HEBE)* project was *to design a new concept of eBook that provides an engaging User eXperience (UX) for children* and consequently *to evaluate the UX with an evaluation method tailored for the reading activity and suitable for children*. Our ambition was to design a children's eBook that could create a better user experience or, to put it in other words, an eBook that could result more engaging for young readers.

We approached the project following a typical User Experience research cycle consisting in five succeeding stages of understanding, study, design, building and evaluation. While the stage of understanding is mostly based on the review of existing research (see Chapter 2), the original contribution of this project can be found in the research we conducted to study children's interaction with (e)Books (Chapter 4), to design (and build) a prototype of engaging eBook (Chapter 5), and to evaluate the prototype (Chapter 6). The following research questions guided our research.

- How can we design children's eBooks to make them more engaging?
- How can leisure reading experience be effectively assessed among primary school children?
- Which aspects of an eBook may contribute to ameliorate children's eReading experience?

These questions were essentially answered by the results we presented in the previous chapters. In the remainder of this chapter we will explicitly

address each of the above questions by summarizing and discussing the results we obtained.

7.1 Answering the Research Questions

7.1.1 How Can We Design Children's EBooks to Make Them More Engaging?

When we studied children's reading experience at the beginning of this research project (see Chapter 4), it emerged that what children like most in reading is the *spur to imagination* and the *pleasure to discover* they get from books. Based on this observation, we hypothesized that an eBook capable of supporting these two aspects of the reading experience would result more engaging for children. In addition, we observed that children involved in this stage of the project adopted various strategies to stay focused on the text, so we also speculated that if an eBook helps young readers to stay focused on the text, it may increase their engagement with the story.

However these were just observations, and needed to be translated into a tangible product in the design/building stages of the project. Since researchers have demonstrated the benefits of including children in the design process (see Chapter 2), we decided not to deviate from the mainstream research in the field of CCI. Therefore for the design phase we employed the Cooperative Inquiry (CI) method, which implies the involvement of children in the role of design partners.

CI has been used with children to develop a wide variety of technology but, to our knowledge, it was the first time that such method was employed to design an eBook. Given the satisfactory result we obtained (see Chapter 5), we confirm its effectiveness in eliciting design ideas and we can recommend its use to the HCI researchers and practitioners who are interested in designing eBooks for children. In fact CI allows combining the expertise of adult designers with that of children who *"are experts at what it means to be a child today"* [5]. Thanks to this approach we have been able to design an eBook that takes into account children's needs, preferences and desiderata, as well as designers' knowledge of guidelines and best practices in design – and craftsmanship in developing digital technologies.

On the flip side of the coin, CI is a resource-intensive method: it usually takes a lot of time and resources to set up a CI study, and our case is not an

exception. In total we spent roughly 40 hours over 5 months to design the eBook prototype together with children. Considering this issue, for those who cannot or do not want to invest such amount of time in the design stage, we elaborated a set of design guidelines that – in the light of our findings – may help to design more engaging eBooks:

1. "It (i.e. the eBook) should not be 'boring": use audiovisual enrichments to allow for different reading paths;
2. "It should have a touch of 'Pathos': provide read-aloud narration of the text;
3. "It should be playful": use interactivity to add value to the eBook and make it more playful;
4. "It should not be too difficult to read": provide in-line dictionary definitions and illustrated descriptive cards;
5. "It should be colorful": use colors to differentiate the various parts in the text;
6. "It has to remain a book though": use non-textual elements carefully and with moderation.

These guidelines do not aim at being prescriptive, for this reason we voluntarily left them quite general in their scope (we might even call them recommendations rather than guidelines).

In general, some of these guidelines seem to suggest that the eBook should allow children to find a balance between the challenges of the reading activity and their skills. Another indication is that interactive and multimedia elements are important, but any design solution or enhancement should contribute in emphasizing the story told by the text, which has to remain the core of the book and the main source of children's engagement.

7.1.2 How Can Leisure Reading Experience be Effectively Assessed Among Primary School Children?

Once we established – given the purpose and the focus of this project – that user engagement was the relevant dimension to assess, the next step was to figure out how two assess it. In Chapter 3 we illustrated the theoretical framework that we used as a basis for the empirical analysis of the eReading experience. After reviewing existing psychological theories, we identified flow theory as the one that offers the best conceptualization of reading engagement. As for the method for evaluating "flow" while reading, our

choice felt on the Experience Sampling Method (ESM) combined with an adapted version of the Flow Short Scale (FKS). The ESM was chosen for two main reasons. First because it is the method mostly employed in research on flow, second because it is the method that best fits with the nature of the reading experience which is typically long, fragmented and sequential (see Chapter 6). As for the FKS, we chose it because it has already been validated and successfully used to assess flow in different activities, yet prior to using it we rephrased some of the items to adapt them to the cognitive skills of primary school children.

The approach we just described allowed us to successfully collect data about children's UX with the eBooks, and with these data we made a comparison between two groups of children who read the *"enhanced"* eBook prototype we developed and the *"basic"* version of the same eBook respectively. We opted for this experimental design in order to have a baseline reference to which compare our eBook prototype and see if the design solutions we implemented would actually contribute to increase children's engagement. The comparison revealed that when children read an eBook designed following the guidelines reported above, their level of flow increases.

While we discuss the implication of this in the following section, what is important to notice here is that ESM and FKS – with the proper precautions – proven to be suitable for being used with 7 to 12 years old children. As far as we know both ESM and FKS were never employed with such age group, therefore our accomplishment provides a first evidence on the possibility to use those methods for conducting HCI research with children, and this opens up new opportunities for further research on the User Experience. As evidenced by Bargas-Avila and Hornbæk [1] UX research entails a need for new methods and approaches for evaluating the user experience, in particular those that emphasizes the situational and dynamic aspects of using interactive products and the importance of context. We believe that ESM can be one of these "new methods" as it allowed us to collect data in a real context of use and, thanks to the repeated measurements, it allowed us to intercept potential variations of user engagement over time. With regard to this last point, ESM does allow researchers to conduct an evaluation that is not limited to a short-term use but that can extend over a longer time frame – i.e. weeks or months. If we consider that to date "the basic research characterizing experience over time is meager" [1], we can easily see how ESM can extend the array of contexts and activities that can be explored by HCI researchers.

It goes without saying the ESM is not a "one size fits all" solution for UX evaluation and it is not exempt from limitations, with the main one being attrition (as we wrote in Section 6.6.1). In an attempt to address this limitation, we developed an ESM iOS application to make the evaluation less burdensome for the participants (see Section 6.3.1), yet there is a lot of room for improvement in this sense.

7.1.3 What Aspects of an EBook May Contribute to Ameliorate Children's EReading Experience?

The results of the evaluation stage we reported in Chapter 6 showed that read-aloud narration was by far the most appreciated feature among the ones we used to enhance the electronic book. We argued that the combination of visual reading with audio reading has the potential to make eReading a more engaging experience. We justified our arguments by referring to the concept of *attention saturation* that is central to flow theory (see Chapter 3 and 6). Our arguments can be extended to other eBook enhancements provided that they give a meaningful contribution to the text, meaning that they should supplement and enhance the text rather than replace it. This would add redundancy to the textual information – thus providing the reader with multiple modes of fruition.

In addition, as we argued in Chapter 3, designing engaging eBooks means designing eBooks aimed at leveraging intrinsic motivations. Therefore in the first place the eBook should address the three aspect of intrinsic motivation associated with leisure reading we mentioned in Chapter 3 – i.e. curiosity, desire for challenge and involvement.

To foster curiosity an eBook should allow for exploratory behavior and for different modes of fruition, this would allow for a non-linear multi-path reading experience that children could tailor to their skills. As we suggested in our design guidelines, providing read-aloud narration of the text or videos that summarize parts of the book may facilitate *weak readers*' text comprehension or may provide *strong readers* with a more challenging reading experience[1].

And this brings us to the second aspect of intrinsic motivation in reading, namely the desire for challenge. In this context "challenge" should be understood as "opportunities for action": eBooks can be designed to give the

[1] As we already wrote in Chapter 3 Research has shown that a good balance between the challenges of a text and a reader's skills is an antecedent of leisure reading.

children the freedom to select the opportunities they perceive as the most challenging and meaningful ones from a subjective point of view. An adequate level of challenge is also one of the key conditions for *flow* to occur [10,11], together with clear proximal goals and immediate feedback [11] (a condition which may also increase self-efficacy).

As for the concept of involvement interestingly enough it is very similar to the dimension of flow[2] and that may explain why flow resonates with reports of (optimal) reading experiences [10]. As a matter of fact the experience of *"being lost in a book"* shares many if not all the characteristics of flow state: focused concentration, merging of action and awareness, loss of reflective self-consciousness, sense of potential control, distortion of temporal experience and experience of the activity as autotelic – i.e. intrinsically rewarding [11]. We can therefore understand the importance of designing an eBook that supports – or at least does not interfere with – the conditions of flow. Possible ways to balance challenges with skills have been already discussed in Chapter 5, but it must be added that in order to provide clear goals and immediate feedback, the eBook should first of all be *usable* and then should not have elements that distracts the user from the activity (see [4], page 73). As we stressed it is important to use interactivity not for the sake of it, but to enhance the reading experience and give a meaningful contribution to the text; otherwise it would be just a distraction for the reader (and a potential barrier to engagement/flow).

Ideally, the various eBook enhancements should also be aimed at promoting internalization of extrinsic motivation for reading. This consideration is supported by Self-Determination Theory (SDT) that we already discussed in Chapter 3. SDT accounts for *determinants of motivation*, which have a crucial role in the maintenance of intrinsic motivation and are also important for promoting the internalization process (simply put: transforming extrinsic motivation in intrinsic motivation).

According to SDT, there are three motivational determinants: perception of autonomy, perception of competence, and perception of relatedness. These motivational determinants can be traced directly to the psychological needs for *autonomy*, *competence*, and *relatedness*, respectively [7]. The need for autonomy concerns *"people's universal urge to be causal agents, to experience volition, to act in accord with their integrated sense of self"*; the need for competence concerns *"people's inherent desire to be effective in dealing with the environment"*; while the need for relatedness *"concerns the*

[2] We thoroughly described both the concept of "involvement" and that of "flow" in Chapter 3

universal propensity to interact with, be connected to, and experience caring for other people" [3]. It follows that the enhancement of the eBook should be designed to help children to feel *competent* and *autonomous* even though the reading was initiated because of extrinsic motivation (e.g. reading a book because asked by the teacher). In our guidelines we suggested to provide in-line dictionary definitions or in-line illustrated descriptive cards to help children to assimilate any new/complex ideas found in the text without any external aid – and therefore make them feel more competent and autonomous.

7.2 Opportunities for Future Research

Given the paucity of research that explores eReading for pleasure and children's engagement with eBooks (see Chapter 2), many opportunities for future research exist.

In this research we focused our attention on the reading process itself, but it might be worth to investigate also what happens before (i.e. book choice) and after (i.e. sharing of reading preferences) as an integral part of reading experience. Hence, it could be interesting to explore alternative ways to support the book choice process in a digital context. For instance, by facilitating serendipitous discover and by providing alternative clues to the readers to allow them to evaluate the eBook at a glance (e.g. a function to leaf through the book, a book trailer, an indicator of book length, an indicator of age appropriateness, etc.).

Speaking of book choice, in this project we evaluated only two versions of an eBook prototype based on a single novel. In line with Nell [12] we acknowledge that *"correct book selection"* is one of the prerequisites for an enjoyable reading experience, thus it would be interesting for the future to replicate the evaluation we conducted by giving participants the opportunity to choose the eBook to read from a set of multiple titles. An additional opportunity could also be to replicate the study in a different country and with a different group of children to see if our observations can be generalized.

As we previously stressed in this and the preceding chapter, it is the first time that ESM and FKS are used with children. Despite the satisfactory results we obtained, other researchers may contribute with new studies where these methods are tested with children, and eventually refine and improve them. It goes without saying, other questionnaires can be used with

the Experience Sampling Method. The choice mainly depends on the dimensions of UX to be assessed and on the population involved in the study. Researchers are free to choose and adapt (or to create) the questionnaires that better suit their scope, but in general the advice is to keep them as short as possible in order to limit the interference with the activity being assessed. At the same time future research should look at how to reduce attrition, that our study confirmed to be one of the main problems researchers have to face when using ESM. Obviously it is crucial to pilot the study in order to set the right parameters for the sampling (e.g. type of alert, scheduling, delivery mechanism, etc.). In addition to that, we should look at ways to keep users motivated throughout the entire study (for instance by linking the compensation for participating to their response rate) and to reduce ESM's disruptiveness (for instance by delivering the questionnaire when the application "senses" that the user can be interrupted).

Eventually, this research project targeted a child user population, but the gap in the research on leisure reading and eBooks is not only related to this specific age group. We evidence the need for future studies to fill this gap by investigating the topic with adolescents and adults.

7.2.1 Experience Sampling in Human-Computer Interaction Research

As we discussed in Section 2.3 the Experience Sampling Method (ESM) allows to assess participants' experience over time and almost in real-time (i.e. while the experience is taking place). Because of that, ESM is now gaining popularity in the HCI field and, as our study showed, it may provide researchers with new insights on how the User Experience (UX) evolves over a period of time of weeks or months and with devices that are intended to accompany users through different tasks and in changing contexts and environments. According to Consolvo and Walker [2]:

> *"A nice feature of ESM is that you can use statistical methods to evaluate the data, a process that is often not possible with studies involving small numbers of participants. In addition, you can collect structured data (fixed responses used to generate quantitative data) and unstructured data (open-ended questions used to generate qualitative data). Because data can be collected over a long period of time, researchers might be able to capture infrequently occurring events. Because no researcher is present,*

> *it might be possible to learn about events not normally accessible to an observer (for example, getting ready for work in the morning or going on a date)"*

Like Consolvo and Walker, we see ESM being used as a formative technique to reveal where new digital technologies might be appropriate and to help define requirements for those technologies. We also see it being used as a summative technique to measure the impact of digital technologies on people's lives. Last but not least, we also see an opportunity to improve ESM by making use of new digital technologies and portable devices.

Our study provided an example of the potential of ESM when deployed on digital devices, in particular the opportunity to combine subjective data collected through questionnaires with the objective data gathered through logs and device's sensors. Considering that *mixed-method* research is thought by many to be the future of UX investigation – see Law [9] – ESM has the right characteristics to become an widespread method of data collection within the HCI research field.

Due to the scope of our study, the "objective" data automatically collected was limited to logging the time when the device was in use to read eBooks and its location in terms of GPS coordinates. For the future we can see opportunities for more sophisticated ESM applications that can collect a wider spectrum of interaction data (i.e. screen taps and gestures, device movements, eye-tracking, heartbeat, skin-conductance, etc.) and that can provide a more fine-grained picture of users' interaction with the device and of their feelings. This will also allow researchers to triangulate the data coming from the ESM questionnaires and to check for the validity and reliability of users' self-reports. It must be said that having such an amount of data available will pose the challenge of how to deal with it without "getting lost", but we already discussed this issue in Section 2.3 – and for more on the topic of ESM data analysis the reader may refer to Larson and Delespaul [8].

7.3 Closing Remarks

EBooks are commonly seen as an opportunity to create some interest around reading and to change the attitude of young readers – reluctant ones in particular – thereby neglecting the role of motivation. Motivation is the inner force that activates/triggers a behavior or act, and it is different from the more general concept of interest and from the one – even more general – of attitude. In our opinion, eBook designers should not aspire at fostering children's interest towards reading or at changing children's attitudes. Or better, as there are many factors (e.g. social context, education, etc.) which come into play when we speak of these two aspects related to reading, the designers should focus on the motivational factor: which means fostering children motivation for reading and promoting internalization of extrinsically motivated behaviors.

With the HEBE project we aimed at better understanding how we can create eBooks that are more engaging for children. Through Cooperative Inquiry we identified a set of guidelines that are intended to help designers in creating eBooks which may foster children's motivation for reading and which may result in a better and more engaging reading experience. In a later stage we conducted an evaluation to see whether an eBook enhanced following these guidelines was actually more engaging than a non-enhanced version of the same eBook. The results we obtained seemed to confirm this hypothesis.

Our hope is that the work we did would help and inspire other researchers and practitioners in the HCI field to create "better" eBooks or, as Alan Kay wrote, eBooks which are *"active like the child rather than passive"* [6]

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Appendix A

ESM Application's Source Code

In this Appendix we report the source code of the Experience Sampling Application we created for this research project. The application was written in the Objective-C programming language and developed by using the Xcode IDE (Integrated Development Environment).

```
//
//  main.m
//  examen
//
//  Created by Luca Colombo on 11/21/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>

#import "ExamenAppDelegate.h"

int main(int argc, char *argv[])
{
    @autoreleasepool {
        return UIApplicationMain(argc, argv, nil,
NSStringFromClass([ExamenAppDelegate class]));
    }
}
```

```
//
//  abbreviations.h
//  examen
//
//  Created by Luca Colombo on 11/30/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//
// Cointains all the abbreviations to access singletons
```

```
//

#define UD [NSUserDefaults standardUserDefaults]
#define SLN [UIApplication sharedApplication].scheduledLocalNotifications
#define APP [UIApplication sharedApplication]
#define LND [LNDispatcher sharedLNDispatcher]
#define INV [Interviewer sharedInterviewer]
```

```
//
//  SingletonMacro.h
//  examen
//
//  Created by Luca Colombo on 11/27/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#ifndef SINGLETON_GCD
#define SINGLETON_GCD(classname)                        \
                                                        \
+ (classname *)shared##classname {                      \
                                                        \
    static dispatch_once_t pred;                        \
    __strong static classname * shared##classname = nil;\
    dispatch_once( &pred, ^{                            \
        shared##classname = [[self alloc] init]; });    \
    return shared##classname;                           \
}
#endif

/* How to use it

In the .h

@interface MyClass : NSObject
    + (MyClass *) sharedMyClass;
@end

and in the .m

#import "MyClass.h"
@implementation MyClass
SINGLETON_GCD(MyClass);
- (id) init {
    if ( (self = [super init]) ) {// Initialization code here.}
return self; }
@end

*/
//
//  ExamenAppDelegate.h
//  examen
```

```
//
//  Created by Luca Colombo on 11/21/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>
#import <CoreLocation/CoreLocation.h>
#import "abbr.h"
#import "LNDispatcher.h"
#import "Interviewer.h"

@interface ExamenAppDelegate : UIResponder <UIApplicationDelegate,
CLLocationManagerDelegate>

@property (strong, nonatomic) UIWindow *window;

- (void)locationManager:(CLLocationManager *)manager didUpdateLocations:(NSArray
*)locations;

@end
```

```
//
//  ExamenAppDelegate.m
//  examen
//
//  Created by Luca Colombo on 11/21/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "ExamenAppDelegate.h"

@implementation ExamenAppDelegate {
    CLLocationManager *locationManager;
}

- (BOOL)application:(UIApplication *)application
didFinishLaunchingWithOptions:(NSDictionary *)launchOptions
{
    if ([UD boolForKey:@"notFirstLaunch"]) {
        //delegate notification handling to didReceiveLocalNotification
        UILocalNotification *notification = [launchOptions
objectForKey:UIApplicationLaunchOptionsLocalNotificationKey];
        [LND loadAllNotifications];
        if (notification!=nil) { //launched from notification
            LND.an = notification;
            [APP cancelLocalNotification:notification];
            //SLN = [NSArray arrayWithArray:SLN]; // trick to reset notification
center;
            [LND setNotificationAnswerDate:[NSDate date]]; //to set answering date
of notification
```

```
            locationManager = [[CLLocationManager alloc] init];
            locationManager.delegate = self; //lazy implementation
            [locationManager startMonitoringSignificantLocationChanges];

        } else { //Launched from app icon
            [LND generateNewNotifications];
        }
    } else { //Launched for the 1ST time
        [application cancelAllLocalNotifications]; // just to be sure
    }

    return YES;
}

- (void)applicationDidEnterBackground:(UIApplication *)application
{
    if ([UD boolForKey:@"notFirstLaunch"]) { //to prevent crash
        [LND saveAllNotifications];
        [locationManager stopMonitoringSignificantLocationChanges];
    }
}


#pragma mark - CLLocationManagerDelegate
- (void)locationManager:(CLLocationManager *)manager didUpdateLocations:(NSArray
*)locations {
    CLLocation *l = [locations lastObject]; //last update
    [INV.deviceLog setValue:[NSNumber numberWithDouble:l.coordinate.latitude]
forKey:@"latitude"];
    [INV.deviceLog setValue:[NSNumber numberWithDouble:l.coordinate.longitude]
forKey:@"longitude"];
}

@end
```

```
//
//  LNDispatcher.h
//  examen
//
//  Created by Luca Colombo on 8/22/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "SingletonMacro.h" //SINGLETON pattern
#import "abbr.h"

@interface LNDispatcher : NSObject

@property (nonatomic, strong) UILocalNotification *an;

+ (LNDispatcher *) sharedLNDispatcher; //SINGLETON pattern
```

```
- (void) generateNewNotifications;
- (void) demo;
- (void) newNotification: (bool) notDemo;
- (void) setNotificationAnswerDate:(NSDate *) answerDate;
- (void) saveAnswers: (NSArray *)a withDeviceLog: (NSArray *) l;
- (bool) loadAllNotifications;
- (bool) saveAllNotifications;

@end
```

```
//
//  LNDispatcher.m
//  examen
//
//  Created by Luca Colombo on 8/22/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "LNDispatcher.h"

@implementation LNDispatcher {
    // "private" instance variables
    NSMutableArray *allNotifications;
    NSString *plist;
    NSString *tsv;
    int i;
}

@synthesize an; //answered notification

SINGLETON_GCD(LNDispatcher);  //SINGLETON pattern

- (id)init {
    if( (self = [super init]) ) {
        // code goes here
        plist = [[UD stringForKey:@"name"] stringByAppendingFormat:@"%@.plist",[UD
stringForKey:@"age"]]; //filename based on the name of the user
        tsv = [[UD stringForKey:@"name"] stringByAppendingFormat:@"%@.tsv",[UD
stringForKey:@"age"]];
    }
    return self;
}

- (void)generateNewNotifications { //to replace expired notifications with new
ones in SLN
    int c = 0;
    while ([SLN count] < [UD integerForKey:@"nnx"]) { //iOs allows to schedule up
to 64 local notifications per app
        [self newNotification: TRUE];
        c++;
    }
```

```
}

- (void)demo { //generates notifications to demonstrate how the app works
    while ([SLN count] < 2) //iOs allows to schedule up to 64 local notifications
per app
        [self newNotification: FALSE];
}

- (void)newNotification: (bool) notDemo {
    UILocalNotification *newNotif;

    newNotif = [SLN lastObject]; //latest scheduled notification

    if (newNotif == nil) { //if first notification to be generated

        newNotif = [UILocalNotification new]; //initialize lastNotif
        newNotif.soundName = UILocalNotificationDefaultSoundName; //default sound
        newNotif.timeZone = [NSTimeZone systemTimeZone]; //default system time
zone
        newNotif.fireDate = [NSDate date]; //current time
    }

    if (notDemo) {
        newNotif.alertBody = [NSString stringWithFormat:@"Come va? Dillo
completando il questionario"];
        //values multiplied per 60 to obtain minutes
        NSInteger ti = [self randAround: ([UD integerForKey:@"si"]*60)
withVariation: ([UD integerForKey:@"siv"]*60)]; //generate random time interval
        newNotif.fireDate = [[newNotif fireDate] dateByAddingTimeInterval:ti];
        [APP scheduleLocalNotification:newNotif];
        [allNotifications addObject: [NSMutableArray arrayWithObject:[self
stringFromDate:newNotif.fireDate]]]; //add last notification fire date to new
notification for persistent storage
    } else { //creates a demo notification after 5 seconds (not saved in
allNotifications)
        newNotif.alertBody = [NSString stringWithFormat:@"Come va? Dillo
completando il questionario (DEMO)"];
        newNotif.fireDate = [[newNotif fireDate] dateByAddingTimeInterval:5];
        newNotif.userInfo = [NSDictionary dictionaryWithObject:[NSNumber
numberWithBool:TRUE] forKey:@"demo"]; //save a flag in userinfo to mark the
notification as demo
        [APP scheduleLocalNotification:newNotif];
    }
}

- (void) setNotificationAnswerDate:(NSDate *) answerDate { // this method saves
the date when notification was answered into allNotifications
    if (![[an userInfo] valueForKey:@"demo"]) { //if demo notification do nothing
        NSMutableArray *o = [NSMutableArray arrayWithObject:[self
stringFromDate:LND.an.fireDate]]; //create array for obtaining index
        i = [allNotifications indexOfObject: o];
        [[allNotifications objectAtIndex:i] addObject:[self
```

```
stringFromDate:answerDate]];
    }
}

- (void) saveAnswers: (NSArray *)a withDeviceLog: (NSArray *) l {
    if (![[an userInfo] valueForKey:@"demo"]) { //if demo notification do nothing
        NSMutableArray *d = [NSMutableArray arrayWithArray:[allNotifications
objectAtIndex:i]];
        [d addObjectsFromArray:a];
        [d addObjectsFromArray:l];
        [allNotifications replaceObjectAtIndex:i withObject: d];
    }
}

#pragma mark I/O methods

- (bool)loadAllNotifications { //load allNotifications from file
    NSArray *a = [NSKeyedUnarchiver unarchiveObjectWithFile: [self
getDocsPathToFile: plist]];
    allNotifications = [NSMutableArray array];
    if (a!=nil) {
        [allNotifications addObjectsFromArray: a];
        return true;
    } else {
        return false;
    }
}

- (bool)saveAllNotifications { //save allNotifications to file
    bool x = [NSKeyedArchiver archiveRootObject:allNotifications toFile:[self
getDocsPathToFile: plist]]; // instead of writeToURL to store non property list
types
    [self exportAllToTSV];
    return x;
}

# pragma mark utility private methods

- (void)exportAllToTSV {
    NSMutableString *tsvout = [NSMutableString string];
    for (id arr in allNotifications) { //transform 2d array of notifications-
answers in string
        for (id ob in arr) {
            [tsvout appendString:[ob description]];
            [tsvout appendString:@"\t"];
        }
        [tsvout appendString:@"\n"];
    }
    NSLog(@"TSV FILE \n%@", tsvout);
    [tsvout writeToFile:[self getDocsPathToFile: tsv] atomically:YES
encoding:NSUTF8StringEncoding error:nil];
}
```

```
- (NSInteger)randAround:(NSInteger)mid withVariation:(NSInteger)v {
    return (NSInteger)mid - v + arc4random_uniform(v*2+1);
}

- (NSString *)getDocsPathToFile: (NSString *) filename {
    NSURL *u = [[[NSFileManager alloc] init] URLForDirectory:NSDocumentDirectory
    inDomain:NSUserDomainMask appropriateForURL:nil create:FALSE error: nil]; //
error-checking omitted
    u = [u URLByAppendingPathComponent:filename];
    return [u path];
}

- (NSString *)stringFromDate: (NSDate *) d {
    NSDateFormatter *dF = [[NSDateFormatter alloc] init];
    [dF setDateFormat:@"yyyy-MM-dd HH:mm:ss"]; //to format the date according to
MS Excel format
    return [dF stringFromDate:d];
}

@end
```

```
//
//  Interviewer.h
//  examen
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "SingletonMacro.h" //SINGLETON pattern
#import "abbr.h"
#import "LNDispatcher.h"

@interface Interviewer : NSObject

@property(nonatomic, strong) NSArray *items;
@property(nonatomic, strong) NSMutableArray *answers;
@property (nonatomic, strong) NSMutableDictionary *deviceLog;

+ (Interviewer *) sharedInterviewer; //SINGLETON pattern

- (void) resetAnswers;
- (void) saveAnswersWithDeviceLog;

@end


//
//  Interviewer.m
//  examen
```

```
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//


#import "Interviewer.h"


@implementation Interviewer

@synthesize items;
@synthesize answers;
@synthesize deviceLog;

SINGLETON_GCD(Interviewer);  //SINGLETON pattern

- (id)init {
    if( (self = [super init]) ) {
        // code goes here
        [self loadItems];
        deviceLog = [NSMutableDictionary dictionary]; //initialize device log
dictionary
    }
    return self;
}

- (bool) loadItems {
    //Reads the questions from the plist file
    NSURL *itemsUrl = [[NSBundle mainBundle] URLForResource:@"items"
withExtension:@"plist"];
    items = [NSArray arrayWithContentsOfURL:itemsUrl];
    if (items!=nil) {
        [self resetAnswers];
        return TRUE;
    }
    else
        return FALSE;
}

- (void) resetAnswers { ////Generates a 2d sparse array based on the items
provided
    answers = [NSMutableArray array];
    for (int i=0; i<items.count; i++) {
        [answers addObject:[NSMutableArray array]];
        for (int j=0; j<[[items objectAtIndex:i] count]; j++) {
            [[answers objectAtIndex:i] addObject:[NSNumber numberWithInt:0]];
        }
    }
}

- (void) saveAnswersWithDeviceLog {
```

```
    NSMutableArray *aa = [NSMutableArray array];
    for (NSMutableArray *section in answers) { //transform 2d array in array
        [aa addObjectsFromArray:section];
    }
    [LND saveAnswers: aa withDeviceLog:[deviceLog allValues]];
}

@end
```

```
//
//  FormViewController.h
//  examen
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>
#import "LikertCell.h"
#import "abbr.h"
#import "Interviewer.h"

@interface FormViewController : UITableViewController <UITableViewDataSource,
UITableViewDelegate, LikertCellDelegate, UIImagePickerControllerDelegate,
UINavigationControllerDelegate> //last protocol declared just to avoid warning
message since UIImagePickerController inherits from UINavigationController

@property (strong, nonatomic) IBOutlet UIBarButtonItem *cameraButton;

- (IBAction)submit:(id)sender;
- (IBAction) useCamera: (id)sender;

@end
```

```
//
//  FormViewController.m
//  examen
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "FormViewController.h"

@implementation FormViewController {
    bool orientationSaved;
}

@synthesize cameraButton;
```

```
- (id)initWithStyle:(UITableViewStyle)style
{
    self = [super initWithStyle:style];
    if (self) {
        //custom initialization
    }
    return self;
}

- (void)viewDidAppear:(BOOL)animated { //device orientation doesn't work in
viewdidload or viewWillAppear
    if (!orientationSaved) { //to save orientation only when appear for the first
time
        [super viewDidAppear:animated];
        NSArray *ors = [NSArray
arrayWithObjects:@"Unknown",@"Portrait",@"UpsideDown",@"LandscapeLeft",@"Landscape
Right",@"FaceUp",@"FaceDown", nil]; //list of orientations
        [INV.deviceLog setValue: [ors objectAtIndex:[[UIDevice currentDevice]
orientation]] forKey:@"orientation"]; //set device orientation in userLog
        orientationSaved = TRUE;
    }
}

- (void)viewWillAppear:(BOOL)animated {
    [super viewWillAppear:animated];
    if (![UD boolForKey:@"notFirstLaunch"]) //show FirstL view on first launch
        [self performSegueWithIdentifier:@"toFirstL" sender:self];
    else if (LND.an == nil) //switch to iBooks when launched from app icon. And
also init LND (1st call to singleton object)
        [APP openURL:[NSURL URLWithString:@"ibooks://"]];
}


#pragma mark - Table view data source

- (NSInteger)numberOfSectionsInTableView:(UITableView *)tableView
{
    // Return the number of sections.
    return [INV.items count];
}


- (NSString *)tableView:(UITableView *)tableView
titleForHeaderInSection:(NSInteger)section
{
    // Asks the data source for the title of the header of the specified section
of the table view.
    return nil; //no titles for table sections
}


- (NSInteger)tableView:(UITableView *)tableView
```

```
numberOfRowsInSection:(NSInteger)section
{
    // Return the number of rows in the section.
    return [[INV.items objectAtIndex:section] count];
}

- (UITableViewCell *)tableView:(UITableView *)tableView
cellForRowAtIndexPath:(NSIndexPath *)indexPath
{
    // Generates programmatically each row of the table.
    static NSString *CellIdentifier = @"LikertCell";
    LikertCell *cell = [tableView dequeueReusableCellWithIdentifier:CellIdentifier
forIndexPath:indexPath];

    if (cell == nil) {
        cell = [[LikertCell alloc] initWithStyle:UITableViewCellStyleDefault
reuseIdentifier:CellIdentifier];
    }

    // Configure the cell...
    NSDictionary *item = [[INV.items objectAtIndex: [indexPath section]]
objectAtIndex: [indexPath row]];

    cell.description.text = [item objectForKey:@"qq"];
    cell.vsx.text = [item objectForKey:@"sx"];
    cell.vdx.text = [item objectForKey:@"dx"];

    // to load the state of the selected segment (otherwise iOs cells reuse will
mess everything up)
    int ss = [[[INV.answers objectAtIndex:[indexPath section]]
objectAtIndex:[indexPath row]] intValue];
    cell.sc.selectedSegmentIndex =  ss - 1;

    return cell;
}

#pragma mark - Submit method

- (IBAction) submit:(id) sender {
    int c = 0;
    for (id section in INV.answers) {  // check if the user has aswered all the
questions
        for (NSNumber *item in section) {
            c++;
            if ([item intValue] == 0) {
                [[[UIAlertView alloc] initWithTitle:@"Questionario incompleto"
message:@"Non hai risposto a tutte le domande" delegate:nil
cancelButtonTitle:@"OK" otherButtonTitles:nil] show];
                return;
            }
        }
    }
```

```
    [INV saveAnswersWithDeviceLog];

    [APP openURL:[NSURL URLWithString:@"ibooks://"]];

    //[self performSegueWithIdentifier:@"toThankY" sender:self];
}

#pragma mark - camera

- (IBAction) useCamera: (id)sender
{
    if ([UIImagePickerController isSourceTypeAvailable:
UIImagePickerControllerSourceTypeCamera])
    {
        UIImagePickerController *imagePicker = [[UIImagePickerController alloc]
init];
        imagePicker.delegate = self;
        imagePicker.sourceType = UIImagePickerControllerSourceTypeCamera;
        imagePicker.mediaTypes = [UIImagePickerController
availableMediaTypesForSourceType: UIImagePickerControllerSourceTypeCamera];
        imagePicker.cameraDevice = UIImagePickerControllerCameraDeviceFront;
        imagePicker.cameraCaptureMode =
UIImagePickerControllerCameraCaptureModeVideo;
        // Displays a control that allows the user to choose picture or movie
capture, if both are available:

        imagePicker.allowsEditing = NO;
        [self presentViewController:imagePicker animated:YES completion:nil];
    }
}

@end
```

```
//
//  FormViewController+Delegates.h
//  examen
//
//  Created by Luca Colombo on 2/11/13.
//  Copyright (c) 2013 Luca Colombo. All rights reserved.
//

#import "FormViewController.h"
#import <MobileCoreServices/MobileCoreServices.h>
#import <AssetsLibrary/AssetsLibrary.h>

@interface FormViewController (Delegates)

- (void)tableView:(UITableView *)tableView didSelectRowAtIndexPath:(NSIndexPath
*)indexPath;
- (void)onLikertCellSegCh:(id)sender cell:(LikertCell *)cell;
```

```
- (void)imagePickerController:(UIImagePickerController *)picker
didFinishPickingMediaWithInfo:(NSDictionary *)info;
- (void)imagePickerControllerDidCancel:(UIImagePickerController *)picker;

@end
```

```
//
//  FormViewController+Delegates.m
//  examen
//
//  Created by Luca Colombo on 2/11/13.
//  Copyright (c) 2013 Luca Colombo. All rights reserved.
//

#import "FormViewController+Delegates.h"

@implementation FormViewController (Delegates) //category containing delegates
required by FormViewController

#pragma mark - tableViewDelegate

- (void)tableView:(UITableView *)tableView didSelectRowAtIndexPath:(NSIndexPath
*)indexPath
{
}

#pragma mark - LikertCellDelegate
- (void)onLikertCellSegCh:(id)sender cell:(LikertCell *)cell
{
    NSIndexPath *ip = [self.tableView indexPathForCell:cell];
    NSNumber *num = [NSNumber numberWithInt:(cell.sc.selectedSegmentIndex+1)];
    [[INV.answers objectAtIndex:[ip section]] replaceObjectAtIndex:[ip row]
withObject:num];
}

#pragma mark UIImagePickerControllerDelegate
- (void)imagePickerController:(UIImagePickerController *)picker
didFinishPickingMediaWithInfo:(NSDictionary *)info {
    [self dismissViewControllerAnimated:YES completion:nil];

    NSString *mediaType = [info objectForKey:UIImagePickerControllerMediaType];
    ALAssetsLibrary *cameraroll = [[ALAssetsLibrary alloc] init]; //access to
library of Photo application

    //defines the completion block to be used later in this method
    void (^compBlock)(NSURL *, NSError *) = ^(NSURL *mediaURL, NSError *error) {
        if (error)
            NSLog(@"%@", error);
        else {
            //the following block has the only purpose to get the filename
            [cameraroll assetForURL:mediaURL resultBlock:^(ALAsset *a) {
```

```
                NSString *fileName = [[a defaultRepresentation] filename];
                [INV.deviceLog setValue:fileName forKey:@"filename"];
            } failureBlock:nil];
        }

        //updates the button to give user feedback
        [[self cameraButton] setTintColor:[UIColor colorWithRed:0.82 green:0.2
blue:0.1 alpha:1]];
        [[self cameraButton] setTitle:@"Video registrato"];

    }; // end of block definition

    if ([mediaType isEqualToString:(NSString *)kUTTypeImage]) { //if image
        UIImage *image = [info objectForKey:UIImagePickerControllerOriginalImage];
        [cameraroll writeImageToSavedPhotosAlbum: [image CGImage]
orientation:(ALAssetOrientation)[image imageOrientation]
completionBlock:compBlock];
    }
    else if ([mediaType isEqualToString:(NSString *)kUTTypeMovie]) { //if video
        NSURL *tempURL = [info objectForKey: UIImagePickerControllerMediaURL];
        if ([cameraroll videoAtPathIsCompatibleWithSavedPhotosAlbum: tempURL])
            [cameraroll writeVideoAtPathToSavedPhotosAlbum:tempURL
completionBlock:compBlock];
    }
}

- (void)imagePickerControllerDidCancel:(UIImagePickerController *)picker {
    [self dismissViewControllerAnimated:YES completion:nil];
}

@end
```

```
//
//  LikertCell.h
//  examen
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>

@interface LikertCell : UITableViewCell

@property (nonatomic, strong) IBOutlet UISegmentedControl *sc;
@property (nonatomic, strong) IBOutlet UILabel *description;
@property (nonatomic, strong) IBOutlet UILabel *vsx;
@property (nonatomic, strong) IBOutlet UILabel *vdx;

// Delegate for the cell
@property (nonatomic, strong) IBOutlet id cellDelegate;
```

```
- (IBAction)onSegCh:(UISegmentedControl *)sender;

@end

//Protocol declaration
@protocol LikertCellDelegate

@optional -(void)onLikertCellSegCh:(id)sender cell:(LikertCell *)cell;

@end
```

```
//
//  LikertCell.m
//  examen
//
//  Created by Luca Colombo on 12/3/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "LikertCell.h"

@implementation LikertCell

@synthesize sc;
@synthesize description;
@synthesize vsx;
@synthesize vdx;
@synthesize cellDelegate;

- (id)initWithStyle:(UITableViewCellStyle)style reuseIdentifier:(NSString
*)reuseIdentifier
{
    if (self) {
        // Initialization code
    }
    return self;
}

- (void)setSelected:(BOOL)selected animated:(BOOL)animated
{
    [super setSelected:selected animated:animated];

    // Configure the view for the selected state
}

#pragma mark - on Segment change

- (IBAction)onSegCh:(UISegmentedControl *)sender
{
    if (cellDelegate!=nil && [cellDelegate
```

```
conformsToProtocol:@protocol(LikertCellDelegate)])
    {
        if ([cellDelegate respondsToSelector:@selector(onLikertCellSegCh:cell:)])
            [cellDelegate onLikertCellSegCh:sender cell:self];
    }
}

@end
```

```
//
//  FirstLViewController.h
//  examen
//
//  Created by Luca Colombo on 11/29/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>
#import "abbr.h"
#import "LNDispatcher.h"

@class FirstLViewController;

@interface FirstLViewController : UITableViewController
@property (strong, nonatomic) IBOutlet UITextField *name;
@property (strong, nonatomic) IBOutletCollection(UILabel) NSArray *labels;
@property (strong, nonatomic) IBOutletCollection(UISlider) NSArray *controls;
@property (strong, nonatomic) IBOutletCollection(id) NSArray *disabledItems;

- (IBAction)controlChangedValue:(UISlider *)sender;
- (IBAction)didEndOnExit:(UITextField *)sender;
- (IBAction)submit:(id)sender;
- (IBAction)onoff:(UISwitch *)sender;

@end
```

```
//
//  FirstLViewController.m
//  examen
//
//  Created by Luca Colombo on 11/29/12.
//  Copyright (c) 2012 Luca Colombo. All rights reserved.
//

#import "FirstLViewController.h"

@implementation FirstLViewController

@synthesize name;
@synthesize controls;
```

```
@synthesize labels;
@synthesize disabledItems;

- (void)viewDidLoad
{
    [super viewDidLoad];
     // Do any additional setup after loading the view, typically from a nib.

    //the following code sorts the IBOutlet collections to preserve correspondence
between labels and controls
    NSComparisonResult (^comparetag) (UIView *l1, UIView *l2)  =
^NSComparisonResult (UIView *l1, UIView *l2) {
        if (l1.tag  < l2.tag) return NSOrderedAscending;
        else if (l1.tag > l2.tag) return NSOrderedDescending;
        else return NSOrderedSame;
    };

    self.labels = [self.labels sortedArrayUsingComparator:comparetag];
    self.controls = [self.controls sortedArrayUsingComparator:comparetag];
}

- (void)viewWillAppear:(BOOL)animated {
    [super viewWillAppear:animated];
    self.navigationItem.hidesBackButton = YES;
}

#pragma mark - Actions

- (IBAction)controlChangedValue:(UISlider *)sender {
    int i = sender.tag-1;
    int v = roundl([sender value]); // Rounds float to an integer
    if (i==1) v = round(v/5)*5; //to round to the nearest five for the 2nd slider
(sampling interval 5 minutes steps)
    [sender setValue:(float)v]; // Sets your slider to this value
    [[labels objectAtIndex:i] setText:[NSString stringWithFormat:@"%u",v]];
}

- (IBAction)didEndOnExit:(UITextField *)sender {
    //to dismiss keyboard
    [sender resignFirstResponder];
}

- (IBAction)submit:(id)sender {
    if ([[name text] isEqualToString:@""]) {
        [[[UIAlertView alloc] initWithTitle:@"Questionario incompleto"
message:@"Inserisci il tuo nome" delegate:nil cancelButtonTitle:@"OK"
otherButtonTitles:nil] show];
        return;
    } else {
        [UD setValue:[name text] forKey:@"name"];
        NSArray *k = [NSArray arrayWithObjects:@"age", @"si", @"siv", @"nnx",
nil];
```

```
        for (UISlider *s in controls) {
            [UD setInteger:s.value forKey:k[s.tag-1]];
        }
        [UD setBool:TRUE forKey:@"notFirstLaunch"];
        [UD synchronize];
        [LND demo];
        [self.navigationController popViewControllerAnimated:NO];
    }
}

- (IBAction)onoff:(UISwitch *)sender {
    for (UILabel *d in disabledItems) {
        d.enabled = sender.on;
    }
}

@end
```

```
//
//  ThankYViewController.h
//  examen
//
//  Created by Luca Colombo on 2/12/13.
//  Copyright (c) 2013 Luca Colombo. All rights reserved.
//

#import <UIKit/UIKit.h>
#import "abbr.h"

@interface ThankYViewController : UIViewController

- (IBAction)returnToIBooks:(UIBarButtonItem *)sender;

@end
```

```
//
//  ThankYViewController.m
//  examen
//
//  Created by Luca Colombo on 2/12/13.
//  Copyright (c) 2013 Luca Colombo. All rights reserved.
//

#import "ThankYViewController.h"

@implementation ThankYViewController

- (void)viewDidLoad
{
```

```
    [super viewDidLoad];
     // Do any additional setup after loading the view, typically from a nib.
}

- (void)viewDidUnload
{
    [super viewDidUnload];
    // Release any retained subviews of the main view.
}

- (void)viewWillAppear:(BOOL)animated {
    [super viewWillAppear:animated];
    self.navigationItem.hidesBackButton = YES;
}

- (IBAction)returnToIBooks:(UIBarButtonItem *)sender {
    [self.navigationController popViewControllerAnimated:NO];
    [APP openURL:[NSURL URLWithString:@"ibooks://"]];
}

@end
```

Appendix B

Collected Data

In this Appendix we report the data we collected during the evaluation stage of the project through the Experience Sampling application. In the following pages the reader can find a table where each row represent a notification triggered by the application. The data is organized in columns: in the first column from the left we have the participant's ID that identifies to which participant the data refers. In the second and third column we have, respectively, the timestamp of when a notification has been displayed on the device and that of when it has been answered by the participant. When the cells in the third and in the following columns are left empty, that means that the participant has not answered the notification: as we reported in Chapter 3 and 6, attrition is one of the main limitations of the ESM. In the remaining columns are reported the answers to each FKS Likert item in the form of a numerical value ranging from a minimum of 1 to a maximum of 5.

P01	04/06/13 16:27											
P01	04/06/13 16:45											
P01	04/06/13 17:08	04/06/13 17:19	5	3	3	5	5	5	5	4	4	4
P01	04/06/13 17:30	04/06/13 17:38	5	4	4	5	5	5	5	4	5	3
P01	04/06/13 17:59											
P01	04/06/13 18:15											
P01	04/06/13 18:32											
P01	04/06/13 18:51											
P01	04/06/13 19:14											
P01	04/06/13 19:31											
P01	04/06/13 19:53	04/06/13 19:57	4	4	4	5	5	5	5	3	4	4
P01	04/06/13 20:12											
P01	04/06/13 20:28											
P01	04/06/13 20:45											
P01	04/06/13 21:08	04/06/13 21:11	4	1	2	5	4	5	4	3	3	4
P01	04/06/13 21:24	04/06/13 21:24	4	1	1	5	5	4	4	1	3	4
P01	04/06/13 21:41	04/06/13 21:41	5	5	5	5	5	5	5	5	4	4
P01	04/06/13 22:04	04/06/13 22:08	5	5	5	5	5	5	5	5	5	5
P01	04/06/13 22:20	04/06/13 22:23	4	1	2	4	3	4	5	2	3	2
P01	04/06/13 22:44											
P01	04/06/13 23:02											
P01	04/06/13 23:18	04/06/13 23:18	5	1	1	5	5	5	4	3	4	3
P01	04/06/13 23:41	04/06/13 23:41	3	2	4	5	3	4	4	3	4	5
P01	05/06/13 21:39	05/06/13 21:39	4	4	3	5	5	4	4	2	3	4
P01	05/06/13 22:00	05/06/13 22:00	5	2	3	5	5	4	5	3	3	1
P01	05/06/13 22:23	05/06/13 22:23	4	3	3	4	5	4	4	2	3	5
P01	05/06/13 22:38	05/06/13 22:38	5	1	1	5	4	2	5	3	5	3
P01	05/06/13 22:55											
P01	05/06/13 23:13											
P01	07/06/13 22:49	07/06/13 22:50	5	3	4	5	4	4	5	3	3	4
P01	07/06/13 23:13											
P01	07/06/13 23:30											
P01	07/06/13 23:45											
P01	09/06/13 22:19	09/06/13 22:19	4	3	3	4	4	4	5	5	5	5
P01	09/06/13 22:40											
P01	10/06/13 21:37											
P01	10/06/13 21:58											
P01	10/06/13 22:17											
P01	10/06/13 22:37											
P01	13/06/13 11:12	13/06/13 11:12	4	1	3	5	4	4	4	1	2	3
P01	13/06/13 11:30	13/06/13 11:34	5	1	1	5	4	4	5	1	1	1
P01	13/06/13 11:54											
P01	13/06/13 12:15											

P02	04/06/13 17:32	04/06/13 17:32	5	5	4	5	5	5	5	4	5	4
P02	04/06/13 17:56											
P02	04/06/13 18:17											
P02	04/06/13 18:40											
P02	04/06/13 19:00											
P02	04/06/13 19:16											
P02	04/06/13 19:40											
P02	04/06/13 20:03											
P02	04/06/13 20:22	04/06/13 20:34										
P02	04/06/13 20:38											
P02	04/06/13 21:04	04/06/13 21:04	5	5	4	5	5	5	5	4	5	4
P02	04/06/13 21:19	04/06/13 21:22	5	5	4	5	4	5	5	4	5	4
P02	04/06/13 21:37											
P02	05/06/13 19:11	05/06/13 19:11	5	5	4	5	5	5	5	4	5	5
P02	05/06/13 19:30	05/06/13 19:30	5	5	5	5	5	5	5	4	5	4
P02	05/06/13 19:47	05/06/13 19:47	5	5	5	5	5	5	5	4	4	4
P02	05/06/13 20:10	05/06/13 20:11	5	5	5	5	5	5	5	4	4	4
P02	05/06/13 20:30	05/06/13 20:30	5	5	4	5	5	5	5	4	4	4
P02	05/06/13 20:54	05/06/13 21:07	5	5	4	5	5	5	5	4	4	4
P02	05/06/13 21:17											
P02	05/06/13 21:40											
P02	05/06/13 22:03											
P02	05/06/13 22:18											
P02	06/06/13 19:35	06/06/13 19:36	5	5	5	5	5	5	5	4	4	4
P02	06/06/13 19:52											
P02	06/06/13 20:12											
P02	06/06/13 20:27											
P02	06/06/13 20:44											
P02	08/06/13 15:07											
P02	08/06/13 15:25											
P02	08/06/13 15:42											
P02	08/06/13 15:59											
P02	08/06/13 16:23											

P03	20/06/13 12:53											
P03	20/06/13 13:16											
P03	20/06/13 13:35											
P03	20/06/13 13:56											
P03	20/06/13 14:20											
P03	20/06/13 14:43											
P03	20/06/13 14:58											
P03	20/06/13 15:20											
P03	20/06/13 15:38											
P03	20/06/13 16:03											
P03	20/06/13 16:26											
P03	20/06/13 16:43											
P03	23/06/13 09:07											
P03	23/06/13 09:22											
P03	23/06/13 09:42											
P03	23/06/13 09:59											
P03	23/06/13 10:19											
P03	23/06/13 10:44											
P03	23/06/13 11:05											
P03	23/06/13 11:27											
P03	23/06/13 11:45											
P03	23/06/13 12:07											
P03	24/06/13 08:40											
P03	24/06/13 09:03	24/06/13 09:11	5	5	5	5	5	5	4	3	5	5
P03	24/06/13 09:23											
P03	24/06/13 09:41											
P03	24/06/13 09:58											
P03	24/06/13 10:22											
P03	24/06/13 10:41											
P03	24/06/13 10:57											
P03	24/06/13 11:15											
P03	24/06/13 11:38											
P03	24/06/13 11:55											
P03	24/06/13 12:18											
P03	24/06/13 12:33											
P03	24/06/13 12:56											
P03	25/06/13 16:14											
P03	25/06/13 16:38											
P03	25/06/13 17:03											
P03	25/06/13 17:26	25/06/13 17:33	5	5	5	5	5	5	5	3	5	5
P03	25/06/13 17:43											
P03	25/06/13 17:58											
P03	25/06/13 19:29											
P03	25/06/13 19:50											
P03	25/06/13 20:12											
P03	25/06/13 20:35											
P03	25/06/13 20:54											
P03	25/06/13 21:11											

P03	25/06/13 21:29											
P03	25/06/13 21:45											
P03	25/06/13 22:06											
P03	25/06/13 22:22											

P04	26/07/13 12:33	26/07/13 12:33	5	4	5	5	4	4	4	5	4	5
P04	26/07/13 12:51	26/07/13 12:51	4	5	5	5	5	4	5	5	5	5
P04	26/07/13 13:14											
P04	26/07/13 13:32											
P04	26/07/13 13:55											
P04	26/07/13 14:19											
P04	26/07/13 14:41											
P04	26/07/13 15:05											
P04	26/07/13 15:22	26/07/13 15:23	5	5	5	5	5	5	5	5	5	5
P04	26/07/13 15:45	26/07/13 15:45	5	5	5	5	5	5	5	5	5	5
P04	26/07/13 16:06	26/07/13 16:06										
P04	26/07/13 16:23											
P04	26/07/13 16:40											
P04	26/07/13 16:56	26/07/13 16:58	5	5	5	5	4	4	5	5	5	5
P04	26/07/13 17:20											
P04	27/07/13 09:22	27/07/13 09:22	5	5	5	5	4	4	5	5	5	5
P04	27/07/13 09:43											
P04	27/07/13 10:02											
P04	27/07/13 10:24											
P04	27/07/13 10:42											
P04	27/07/13 11:04	27/07/13 11:10	5	5	5	5	4	5	5	5	5	5
P04	27/07/13 11:22											
P04	27/07/13 11:42											
P04	27/07/13 12:02											
P04	27/07/13 12:20											
P04	27/07/13 12:41											
P04	27/07/13 13:01											
P04	27/07/13 13:18											
P04	27/07/13 13:39											
P04	27/07/13 13:57											
P04	27/07/13 14:15	27/07/13 14:15	5	5	5	5	5	5	5	5	5	5
P04	27/07/13 14:40											
P04	27/07/13 15:01											
P04	27/07/13 15:21											
P04	27/07/13 15:38											
P04	27/07/13 15:57											
P04	27/07/13 16:21											
P04	27/07/13 16:37											
P04	27/07/13 16:53											
P04	27/07/13 17:16											
P04	27/07/13 17:35											
P04	27/07/13 19:32											
P04	27/07/13 19:56	27/07/13 20:03	5	5	5	5	5	5	5	5	5	5
P04	28/07/13 10:21											
P04	28/07/13 10:42											
P04	28/07/13 11:06	28/07/13 11:06										
P04	28/07/13 11:21	28/07/13 11:22										
P04	28/07/13 11:41	28/07/13 12:18	5	5	5	5	5	5	5	5	5	5

P04	28/07/13 12:04											
P04	28/07/13 12:25	28/07/13 12:25										
P04	28/07/13 12:48	28/07/13 12:59	5	5	5	5	5	5	5	5	5	5
P04	28/07/13 13:07											
P04	28/07/13 13:28											
P04	28/07/13 13:45											
P04	28/07/13 14:04											
P04	28/07/13 14:23											
P04	28/07/13 14:44	28/07/13 14:46	5	5	5	5	5	5	5	5	5	5
P04	28/07/13 20:09	28/07/13 20:09	5	5	5	5	5	5	5	5	5	5
P04	28/07/13 20:33											
P04	28/07/13 20:58											
P04	29/07/13 13:13	29/07/13 13:13	5	5	5	5	5	5	5	5	5	5
P04	29/07/13 13:30											
P04	29/07/13 13:50											
P04	29/07/13 14:11											
P04	29/07/13 14:29	30/07/13 14:37	5	5	5	5	5	5	5	5	5	5
P04	29/07/13 14:45											

P05	05/06/13 13:24	05/06/13 13:40	5	4	5	5	5	5	4	5	5	5
P05	05/06/13 13:51	05/06/13 13:51	5	5	4	5	5	5	4	4	4	5
P05	05/06/13 14:15											
P05	05/06/13 14:32											
P05	05/06/13 14:49											
P05	05/06/13 15:06											
P05	05/06/13 15:30											
P05	05/06/13 15:47											
P05	05/06/13 16:08											
P05	05/06/13 16:27											
P05	05/06/13 16:43	05/06/13 16:44	5	5	5	5	5	5	5	5	5	5
P05	05/06/13 19:37											
P05	05/06/13 19:56											
P05	05/06/13 20:15											
P05	05/06/13 20:36											
P05	05/06/13 20:51											
P05	05/06/13 21:15											
P05	05/06/13 21:38											
P05	05/06/13 22:01											
P05	05/06/13 22:25											
P05	06/06/13 20:36	06/06/13 20:37	5	5	5	5	5	5	5	5	5	5
P05	06/06/13 20:53	06/06/13 20:53	5	5	4	5	5	5	5	5	5	5
P05	06/06/13 21:16	06/06/13 21:16										
P05	06/06/13 21:36											
P05	06/06/13 21:59											
P05	06/06/13 22:14											
P05	08/06/13 07:46	08/06/13 07:46	5	5	5	5	5	5	5	3	3	5
P05	08/06/13 08:11	08/06/13 08:12	5	5	4	5	5	5	5	5	3	5
P05	08/06/13 08:27											
P05	08/06/13 08:47	08/06/13 08:47	5	5	5	5	5	5	5	5	5	5
P05	08/06/13 09:02											
P05	08/06/13 09:22											
P05	08/06/13 09:37											
P05	08/06/13 09:56											
P05	08/06/13 10:15											
P05	08/06/13 10:32											
P05	08/06/13 10:53											
P05	08/06/13 11:17											

P06	27/07/13 09:18	27/07/13 09:22	2	5	5	4	1	3	4	5	3	2
P06	27/07/13 09:41	27/07/13 09:41										
P06	27/07/13 09:59											
P06	27/07/13 10:18											
P06	27/07/13 10:34											
P06	27/07/13 10:58											
P06	27/07/13 11:17											
P06	27/07/13 11:41											
P06	27/07/13 12:01											
P06	27/07/13 12:25											
P06	27/07/13 12:47											
P06	27/07/13 13:05	27/07/13 13:06	3	2	2	3	4	5	4	5	1	5
P06	02/08/13 11:41	02/08/13 11:41	3	5	5	4	5	5	5	3	2	3
P06	02/08/13 11:59											
P06	02/08/13 12:19											
P06	02/08/13 12:36	02/08/13 12:36	2	3	1	3	4	3	5	1	5	3
P06	02/08/13 13:00											
P06	02/08/13 13:20											
P06	02/08/13 13:37											
P06	02/08/13 14:01											
P06	02/08/13 14:19											
P06	02/08/13 14:41											

P07	03/07/13 15:42	03/07/13 15:42	5	5	5	5	5	5	5	5	5	5
P07	03/07/13 16:05											
P07	03/07/13 16:26	03/07/13 16:38	5	5	3	5	5	5	5	5	5	5
P07	03/07/13 16:48	03/07/13 16:52	3	3	3	5	5	4	5	3	3	2
P07	03/07/13 17:08	03/07/13 17:08	5	4	4	5	5	5	5	5	3	4
P07	03/07/13 17:24	03/07/13 17:24	3	5	4	5	5	5	5	3	3	3
P07	03/07/13 17:48											
P07	03/07/13 18:09											
P07	03/07/13 18:33											
P07	03/07/13 18:53											
P07	03/07/13 19:10											
P07	03/07/13 19:33											
P07	03/07/13 19:57	03/07/13 20:07	5	5	4	5	5	5	5	5	5	5
P07	03/07/13 20:22	03/07/13 20:27	5	5	5	5	5	5	5	5	5	5
P07	03/07/13 20:37	03/07/13 20:38										
P07	03/07/13 21:01											
P07	03/07/13 21:25											
P07	03/07/13 21:42											
P07	05/07/13 13:36											
P07	05/07/13 13:58											
P07	05/07/13 14:15											
P07	05/07/13 14:37											
P07	05/07/13 14:59											
P07	05/07/13 15:21											
P07	06/07/13 11:44	06/07/13 11:50	5	5	5	5	5	5	5	5	5	5
P07	06/07/13 12:06	06/07/13 12:06	3	3	5	5	5	5	5	5	5	3
P07	06/07/13 12:28											
P07	06/07/13 12:46											
P07	06/07/13 13:08											
P07	06/07/13 13:28											
P07	06/07/13 13:51											
P07	06/07/13 14:13											
P07	06/07/13 14:30											
P07	06/07/13 14:51											
P07	06/07/13 15:12											

P08	20/06/13 17:07											
P08	20/06/13 17:29	27/06/13 09:50	5	5	5	5	5	5	5	5	5	5
P08	20/06/13 17:51	27/06/13 09:49	5	5	5	5	5	5	5	5	5	5
P08	20/06/13 18:12	27/06/13 09:49	5	5	5	5	5	5	5	5	5	5
P08	20/06/13 18:28	27/06/13 09:50	5	5	5	5	5	5	5	5	5	5
P08	20/06/13 18:46	27/06/13 09:49	5	5	5	5	5	5	5	5	5	5
P08	20/06/13 19:03											
P08	20/06/13 19:18											
P08	21/06/13 15:51	21/06/13 16:01										
P08	21/06/13 16:15	21/06/13 16:24										
P08	21/06/13 16:34	21/06/13 16:35										
P08	21/06/13 16:52	21/06/13 16:54										
P08	21/06/13 17:14											
P08	21/06/13 17:29	21/06/13 17:48	5	5	5	5	5	5	5	5	5	5
P08	21/06/13 17:51											
P08	21/06/13 18:12											
P08	21/06/13 18:33											
P08	21/06/13 18:48											
P08	21/06/13 19:05											
P08	21/06/13 19:21											
P08	22/06/13 22:15	22/06/13 22:15	5	5	5	5	5	5	5	5	5	5
P08	22/06/13 22:39	22/06/13 22:48										
P08	23/06/13 13:40	23/06/13 13:40	5	5	5	5	5	5	5	5	5	5
P08	23/06/13 14:00	23/06/13 14:23										
P08	23/06/13 14:15	23/06/13 14:16										
P08	23/06/13 14:39	23/06/13 14:39	5	5	5	5	5	5	5	5	5	5
P08	23/06/13 15:01											
P08	23/06/13 15:19											
P08	23/06/13 15:34											
P08	23/06/13 15:49											
P08	23/06/13 16:08											
P08	23/06/13 16:29											
P08	23/06/13 16:46											
P08	23/06/13 17:03											
P08	23/06/13 17:21											
P08	24/06/13 11:25											
P08	24/06/13 11:43	24/06/13 11:44	5	5	5	5	5	5	5	5	5	5
P08	24/06/13 11:58	24/06/13 11:59	5	5	5	5	5	5	5	5	5	5
P08	24/06/13 12:22											
P08	24/06/13 12:45											
P08	24/06/13 13:08											
P08	24/06/13 13:27											
P08	24/06/13 13:42											
P08	24/06/13 14:04											
P08	24/06/13 14:23											
P08	24/06/13 22:07											
P08	26/06/13 16:15	26/06/13 16:15	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 16:33											

P08	26/06/13 16:53											
P08	26/06/13 17:13											
P08	26/06/13 17:35											
P08	26/06/13 17:53											
P08	26/06/13 18:09											
P08	26/06/13 18:28											
P08	26/06/13 18:50											
P08	26/06/13 19:10	26/06/13 19:11	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 19:32	26/06/13 19:38	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 21:27	26/06/13 21:38	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 21:50	26/06/13 21:52	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 22:11	26/06/13 22:12	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 22:27	26/06/13 22:27	5	5	5	5	5	5	5	5	5	5
P08	26/06/13 22:48											
P08	26/06/13 23:13											
P08	27/06/13 09:48											
P08	27/06/13 10:08											
P08	27/06/13 10:28											
P08	27/06/13 10:46	27/06/13 10:53	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 11:10	27/06/13 11:11	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 11:33	27/06/13 11:34	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 11:56	27/06/13 11:59	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 12:14	27/06/13 12:15	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 12:35	27/06/13 12:35	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 12:54	27/06/13 12:54	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 13:16	27/06/13 13:16	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 13:39											
P08	27/06/13 13:54											
P08	27/06/13 14:18											
P08	27/06/13 14:39											
P08	27/06/13 15:02											
P08	27/06/13 15:20											
P08	27/06/13 15:43	27/06/13 15:49	5	5	5	5	5	5	5	5	5	5
P08	27/06/13 16:07											
P08	27/06/13 16:28											
P08	27/06/13 16:46											

P09	19/06/13 15:05	19/06/13 15:05	5	5	3	5	5	5	4	5	5	5
P09	19/06/13 15:22	19/06/13 15:33	5	4	5	5	5	5	5	5	5	5
P09	19/06/13 15:42	19/06/13 15:44	5	5	5	5	5	5	5	5	5	5
P09	19/06/13 16:03	19/06/13 16:03	5	5	5	5	5	5	5	5	5	5
P09	19/06/13 16:21	19/06/13 16:28	5	5	5	5	5	5	5	5	5	5
P09	19/06/13 16:37	19/06/13 16:38	5	5	5	5	5	5	5	5	5	5
P09	19/06/13 16:53											
P09	19/06/13 17:10											
P09	19/06/13 17:33											
P09	19/06/13 17:57											
P09	19/06/13 18:14											
P09	19/06/13 18:36											
P09	19/06/13 18:52	20/06/13 18:55	5	5	5	5	5	5	5	5	5	5
P09	19/06/13 19:14											
P09	20/06/13 10:05											
P09	20/06/13 10:21											
P09	20/06/13 10:36											
P09	20/06/13 10:59											
P09	20/06/13 21:04											
P09	20/06/13 21:23	20/06/13 21:24	5	5	5	5	5	5	5	5	5	5
P09	20/06/13 21:40	20/06/13 21:48	5	5	5	5	5	5	5	5	5	5
P09	20/06/13 21:58											
P09	20/06/13 22:15											
P09	20/06/13 22:40											
P09	21/06/13 09:44											
P09	21/06/13 10:00											
P09	21/06/13 10:19											
P09	21/06/13 10:43											
P09	25/06/13 22:30											
P09	25/06/13 22:47											
P09	29/06/13 19:23											
P09	29/06/13 19:45											
P09	29/06/13 20:10											
P09	29/06/13 20:29											
P09	29/06/13 20:48											
P09	29/06/13 21:05											
P09	29/06/13 21:22											
P09	29/06/13 21:38											
P09	29/06/13 21:56											
P09	29/06/13 22:14											

P10	05/06/13 20:52											
P10	05/06/13 21:16											
P10	05/06/13 21:34											
P10	05/06/13 21:51											
P10	05/06/13 22:08											
P10	05/06/13 22:29											
P10	06/06/13 10:21											
P10	06/06/13 10:44	06/06/13 10:46										
P10	06/06/13 11:05											
P10	06/06/13 11:27											
P10	06/06/13 11:49											
P10	06/06/13 12:10											
P10	06/06/13 12:28	06/06/13 12:40										
P10	06/06/13 12:45	06/06/13 12:59										
P10	06/06/13 13:05											
P10	06/06/13 13:26											
P10	06/06/13 13:49											
P10	06/06/13 14:12											
P10	06/06/13 14:30											
P10	06/06/13 14:54											
P10	06/06/13 15:16											
P10	06/06/13 15:35											
P10	06/06/13 15:58											
P10	06/06/13 16:16	06/06/13 16:30										
P10	06/06/13 20:44	06/06/13 20:50	4	3	4	5	4	4	4	5	4	5
P10	06/06/13 21:02	06/06/13 21:02										
P10	06/06/13 21:27											
P10	06/06/13 21:50											
P10	06/06/13 22:14											
P10	06/06/13 22:35											
P10	06/06/13 22:54											
P10	08/06/13 10:08											
P10	08/06/13 10:26											
P10	08/06/13 10:41	08/06/13 10:45										
P10	08/06/13 10:58	08/06/13 10:59										
P10	08/06/13 11:18											
P10	08/06/13 11:36											
P10	08/06/13 12:01											
P10	08/06/13 12:22											
P10	08/06/13 12:43											
P10	08/06/13 13:02											
P10	08/06/13 13:23											
P10	08/06/13 18:58	08/06/13 18:59										
P10	08/06/13 19:22											
P10	08/06/13 19:46	08/06/13 19:56										
P10	08/06/13 20:07											
P10	08/06/13 20:28											
P10	08/06/13 20:44											

P10	08/06/13 21:08	08/06/13 21:19										
P10	08/06/13 21:26											
P10	08/06/13 23:42											

P11	19/06/13 18:23	19/06/13 18:23	5	5	5	5	5	5	5	5	5	5
P11	19/06/13 18:48	19/06/13 18:48	5	5	5	5	5	5	5	5	5	5
P11	19/06/13 19:07											
P11	19/06/13 19:32											
P11	19/06/13 19:56											
P11	19/06/13 20:15											
P11	19/06/13 20:36	19/06/13 20:38	5	5	5	5	5	5	5	5	5	5
P11	19/06/13 20:51											
P11	19/06/13 21:11											
P11	19/06/13 21:27											
P11	20/06/13 08:11	20/06/13 08:12	5	5	5	5	5	5	5	4	5	5
P11	20/06/13 08:36	20/06/13 08:38	5	5	5	5	5	5	5	5	5	4
P11	20/06/13 08:57											
P11	20/06/13 09:19											
P11	20/06/13 09:34											
P11	20/06/13 09:52											
P11	20/06/13 10:12											
P11	20/06/13 10:34											
P11	20/06/13 10:57											
P11	20/06/13 11:17											
P11	20/06/13 11:38	20/06/13 11:47	5	5	5	5	4	5	5	5	4	4
P11	20/06/13 16:27	20/06/13 16:27	5	5	5	5	5	5	5	5	5	5
P11	20/06/13 16:49	20/06/13 16:50	5	5	5	5	5	5	4	5	5	5
P11	20/06/13 17:07	20/06/13 17:10	5	5	5	5	5	5	5	5	5	5
P11	20/06/13 17:22	20/06/13 17:22	5	5	5	5	5	5	5	5	5	5
P11	20/06/13 17:41	20/06/13 17:49	5	5	5	5	5	5	5	5	5	5
P11	20/06/13 18:01	20/06/13 18:15	5	5	5	5	5	5	5	5	5	5
P11	20/06/13 18:22	20/06/13 18:22	5	5	5	5	5	5	5	5	4	4
P11	20/06/13 18:44											
P11	20/06/13 19:03											
P11	20/06/13 19:18	21/06/13 19:19	5	5	5	5	5	5	5	4	5	5
P11	20/06/13 19:40	21/06/13 19:46	5	5	5	5	5	5	5	5	5	5
P11	24/06/13 20:41											
P11	24/06/13 21:04											
P11	24/06/13 21:28											
P11	24/06/13 21:46											
P11	24/06/13 22:08	24/06/13 22:10	5	5	5	5	5	5	5	4	4	5
P11	24/06/13 22:26											
P11	24/06/13 22:47											
P11	24/06/13 23:09											
P11	24/06/13 23:30											
P11	24/06/13 23:46											

P12	14/08/13 11:20	14/08/13 11:20	4	2	2	3	4	4	5	4	3	3
P12	14/08/13 11:38											
P12	14/08/13 12:01											
P12	14/08/13 12:25											
P12	14/08/13 12:43											
P12	14/08/13 13:06	14/08/13 13:21	4	1	3	4	5	4	4	3	4	3
P12	14/08/13 13:24											
P12	14/08/13 13:49											
P12	14/08/13 14:12											
P12	14/08/13 14:35											
P12	14/08/13 14:56											
P12	14/08/13 15:18											
P12	14/08/13 15:41											
P12	14/08/13 16:06											
P12	14/08/13 16:29											
P12	14/08/13 16:52											
P12	14/08/13 17:13	14/08/13 17:13	4	2	1	4	3	4	2	1	2	3
P12	14/08/13 17:31											
P12	14/08/13 17:49											
P12	14/08/13 18:05											
P12	14/08/13 18:28											
P12	15/08/13 10:34	15/08/13 10:27	4	2	3	5	4	5	3	1	1	3
P12	15/08/13 10:57											
P12	15/08/13 11:22											
P12	15/08/13 11:45											
P12	15/08/13 12:08											
P12	15/08/13 12:28											
P12	15/08/13 12:48											
P12	15/08/13 13:12	15/08/13 13:20	5	4	3	5	5	5	3	4	2	3
P12	15/08/13 13:32	15/08/13 14:25	4	4	4	4	5	4	4	4	4	2
P12	15/08/13 13:56											
P12	15/08/13 14:15											
P12	15/08/13 14:35											
P12	15/08/13 22:00											
P12	15/08/13 22:19											
P12	15/08/13 22:44	15/08/13 22:55	5	4	4	5	5	3	4	5	3	3
P12	15/08/13 23:00	15/08/13 23:15	3	3	3	5	4	5	3	3	3	2
P12	15/08/13 23:19											
P12	15/08/13 23:37											
P12	15/08/13 23:58											
P12	16/08/13 00:14											
P12	16/08/13 00:33											
P12	16/08/13 00:57											
P12	16/08/13 01:16											
P12	16/08/13 01:41											
P12	16/08/13 01:57											
P12	16/08/13 10:57	16/08/13 11:05	4	2	1	5	5	4	3	4	3	4
P12	16/08/13 11:17											

P12	16/08/13 11:37	16/08/13 11:55	5	4	4	5	5	5	4	5	5	5
P12	16/08/13 11:59	16/08/13 12:00	5	3	4	5	4	3	2	3	4	4
P12	16/08/13 12:19											
P12	16/08/13 12:43											
P12	16/08/13 13:07											
P12	16/08/13 13:31											
P12	16/08/13 13:50											
P12	16/08/13 14:13											
P12	16/08/13 14:30	16/08/13 14:35	5	3	2	5	4	1	2	5	4	4
P12	16/08/13 14:50											
P12	16/08/13 15:12	16/08/13 15:12	5	4	3	4	4	3	1	4	3	3
P12	16/08/13 15:30	16/08/13 15:33										
P12	16/08/13 15:46	16/08/13 15:46	4	3	5	3	4	2	1	1	1	1
P12	16/08/13 16:06											
P12	16/08/13 16:28											
P12	16/08/13 16:51											
P12	16/08/13 17:07											
P12	16/08/13 17:30											
P12	16/08/13 17:47	16/08/13 17:50										
P12	19/08/13 20:11	19/08/13 20:20	5	5	5	5	5	5	5	5	5	5
P12	19/08/13 20:32											
P12	19/08/13 20:54	19/08/13 21:07	5	5	5	5	5	5	5	5	5	5
P12	19/08/13 21:14											
P12	19/08/13 21:31											
P12	19/08/13 21:54											
P12	19/08/13 22:11											
P12	19/08/13 22:27											
P12	19/08/13 22:51											
P12	19/08/13 23:06	19/08/13 23:06	4	3	4	5	4	3	4	4	3	3

P13	14/08/13 11:20										
P13	14/08/13 11:36										
P13	14/08/13 12:01										
P13	14/08/13 12:22										
P13	14/08/13 12:41										
P13	14/08/13 13:06										
P13	14/08/13 13:22										
P13	14/08/13 13:43										
P13	14/08/13 14:05										
P13	14/08/13 14:24	14/08/13 14:30	5	5	4	5	5	5	4	4	4	2
P13	14/08/13 17:01										
P13	14/08/13 17:24										
P13	14/08/13 17:47										
P13	14/08/13 18:05										
P13	14/08/13 18:22										
P13	14/08/13 18:39										
P13	14/08/13 19:02										
P13	14/08/13 19:17										
P13	14/08/13 19:38										
P13	14/08/13 20:02										
P13	14/08/13 20:23										
P13	14/08/13 20:43	14/08/13 20:48	5	5	5	4	5	5	4	3	3	2
P13	14/08/13 21:07										
P13	14/08/13 21:28										
P13	14/08/13 21:52										
P13	14/08/13 22:11	14/08/13 22:13	5	4	4	5	5	4	4	3	4	2
P13	14/08/13 22:35										
P13	14/08/13 22:54										
P13	15/08/13 10:46	15/08/13 10:48	5	4	4	5	5	4	4	4	4	2
P13	15/08/13 11:05	15/08/13 11:06	5	5	4	5	5	5	5	4	4	2
P13	15/08/13 11:29										
P13	15/08/13 11:53										
P13	15/08/13 12:11	15/08/13 12:11	5	4	4	5	5	5	5	4	4	1
P13	15/08/13 12:33										
P13	15/08/13 12:48										
P13	15/08/13 13:13										
P13	15/08/13 13:31	15/08/13 13:33	5	5	5	5	5	5	5	5	4	1
P13	15/08/13 13:50										
P13	15/08/13 14:11										
P13	15/08/13 14:36	15/08/13 14:52	5	5	5	5	5	5	5	4	4	2
P13	15/08/13 14:59										
P13	15/08/13 15:18										
P13	15/08/13 15:38										
P13	15/08/13 15:59										
P13	15/08/13 22:20	15/08/13 22:20	5	4	4	5	5	5	5	4	4	2
P13	16/08/13 14:55	16/08/13 14:55	5	5	5	5	5	5	5	5	5	1
P13	16/08/13 15:11										
P13	16/08/13 15:35										

P13	16/08/13 15:58											
P13	16/08/13 16:18											
P13	16/08/13 16:37											
P13	16/08/13 16:55											
P13	16/08/13 17:17											
P13	16/08/13 17:34											
P13	16/08/13 17:58	16/08/13 18:01	5	5	5	5	5	5	5	5	4	2
P13	16/08/13 22:40											
P13	17/08/13 13:05											
P13	17/08/13 13:26											
P13	17/08/13 13:45	17/08/13 13:46	5	5	5	5	5	5	5	5	4	2
P13	17/08/13 14:01											
P13	17/08/13 14:25											
P13	17/08/13 14:43											
P13	17/08/13 15:01											
P13	17/08/13 15:19											
P13	17/08/13 15:34											
P13	17/08/13 15:51	17/08/13 15:55	5	5	5	5	5	5	5	5	4	2
P13	23/08/13 09:58	23/08/13 09:59	5	4	4	5	5	5	5	4	4	1
P13	23/08/13 10:13											
P13	23/08/13 10:38											
P13	23/08/13 10:58											
P13	23/08/13 11:18											
P13	23/08/13 11:42											
P13	23/08/13 12:00											
P13	23/08/13 12:19											
P13	23/08/13 12:40											
P13	23/08/13 13:02											

P14	17/08/13 18:36											
P14	17/08/13 18:51	17/08/13 18:51										
P14	17/08/13 19:14											
P14	17/08/13 19:37											
P14	17/08/13 19:54											
P14	17/08/13 20:13											
P14	17/08/13 20:36											
P14	17/08/13 21:00											
P14	17/08/13 21:23											
P14	17/08/13 21:42											
P14	18/08/13 10:38	18/08/13 10:38	5	4	5	5	4	4	4	3	4	3
P14	18/08/13 10:55											
P14	18/08/13 11:14											
P14	18/08/13 11:38											
P14	18/08/13 12:01											
P14	18/08/13 12:22											
P14	18/08/13 12:40											
P14	18/08/13 12:56											
P14	18/08/13 13:15											
P14	18/08/13 13:34											
P14	18/08/13 13:58											
P14	19/08/13 12:09	19/08/13 12:09	4	5	5	5	4	5	4	5	5	5
P14	19/08/13 12:31											
P14	19/08/13 12:47											
P14	19/08/13 13:09											
P14	19/08/13 13:28											
P14	19/08/13 13:44											
P14	19/08/13 14:08											
P14	19/08/13 14:26											
P14	19/08/13 14:45											
P14	19/08/13 15:02											
P14	20/08/13 14:31											
P14	20/08/13 14:46											
P14	20/08/13 15:06											
P14	20/08/13 15:23	20/08/13 15:30	5	5	5	5	5	5	5	5	5	4
P14	20/08/13 15:44	20/08/13 15:44	5	5	5	5	4	5	4	5	5	4
P14	20/08/13 15:59											
P14	20/08/13 16:15											
P14	20/08/13 16:36											
P14	20/08/13 18:37											
P14	21/08/13 10:32	21/08/13 10:32	5	4	5	5	4	5	4	5	5	5
P14	21/08/13 10:56											
P14	21/08/13 11:13											
P14	21/08/13 11:34											
P14	21/08/13 11:50											
P14	21/08/13 12:15											
P14	21/08/13 12:36											
P14	21/08/13 12:53											

P14	21/08/13 13:10											
P14	21/08/13 13:33											
P14	21/08/13 13:54											

P15	05/08/13 12:07											
P15	05/08/13 12:25											
P15	05/08/13 12:46	05/08/13 12:59	5	4	4	5	5	5	5	4	5	5
P15	05/08/13 13:06											
P15	05/08/13 13:23											
P15	05/08/13 13:46											
P15	05/08/13 14:09											
P15	05/08/13 14:31											
P15	05/08/13 14:54											
P15	05/08/13 15:16											
P15	06/08/13 11:10	06/08/13 11:28	5	4	4	5	5	5	5	4	4	5
P15	06/08/13 11:26											
P15	06/08/13 11:45											
P15	06/08/13 12:06											
P15	06/08/13 12:25											
P15	06/08/13 12:41											
P15	06/08/13 13:02											
P15	06/08/13 13:22											
P15	06/08/13 13:37											
P15	06/08/13 13:59											
P15	07/08/13 11:27											
P15	07/08/13 11:50	07/08/13 11:51	5	5	5	5	5	5	5	4	5	5
P15	07/08/13 12:12											
P15	07/08/13 12:27											
P15	07/08/13 12:50											
P15	07/08/13 13:14											
P15	07/08/13 13:37											
P15	08/08/13 09:15											
P15	08/08/13 09:31	08/08/13 09:32	5	4	3	4	5	5	5	3	3	4
P15	08/08/13 09:49											
P15	08/08/13 10:12											
P15	08/08/13 10:36											
P15	08/08/13 10:58											
P15	08/08/13 11:19											
P15	08/08/13 11:43											
P15	08/08/13 11:59											
P15	08/08/13 12:15											
P15	09/08/13 11:08											
P15	09/08/13 11:30											
P15	09/08/13 11:50											
P15	09/08/13 12:08											
P15	09/08/13 12:29	09/08/13 12:29	5	5	4	5	5	5	5	4	4	4
P15	09/08/13 12:49											
P15	09/08/13 13:12											
P15	09/08/13 13:28											
P15	09/08/13 13:52											
P15	09/08/13 14:15											
P15	12/08/13 11:08											

P15	12/08/13 11:27											
P15	12/08/13 11:46	12/08/13 11:55	5	5	4	4	5	5	5	4	4	4
P15	12/08/13 12:11											
P15	12/08/13 12:32											
P15	12/08/13 12:52											
P15	12/08/13 13:07											
P15	12/08/13 13:29											
P15	12/08/13 13:52											
P15	12/08/13 14:15											
P15	13/08/13 14:55											
P15	13/08/13 15:17											
P15	13/08/13 15:36											
P15	13/08/13 15:56	13/08/13 15:56	5	5	4	5	5	5	5	4	4	4
P15	13/08/13 16:14											
P15	13/08/13 16:30											
P15	13/08/13 16:53											
P15	13/08/13 17:17											
P15	13/08/13 17:40											
P15	13/08/13 18:04	13/08/13 18:08	5	4	4	5	5	5	5	4	4	4

P16	23/08/13 20:55	23/08/13 20:56										
P16	23/08/13 21:18											
P16	23/08/13 21:35											
P16	23/08/13 21:55											
P16	23/08/13 22:19											
P16	23/08/13 22:42											
P16	23/08/13 23:04											
P16	23/08/13 23:26											
P16	23/08/13 23:48											
P16	24/08/13 00:13											
P16	24/08/13 18:21	24/08/13 18:25	4	4	4	4	4	4	4	4	4	4
P16	24/08/13 18:42											
P16	24/08/13 19:00	24/08/13 19:07	4	4	4	4	4	4	4	4	4	4
P16	24/08/13 19:24											
P16	24/08/13 19:43											
P16	24/08/13 20:06											
P16	24/08/13 20:27											
P16	24/08/13 20:43											
P16	24/08/13 21:00											
P16	24/08/13 21:22											
P16	25/08/13 14:13	25/08/13 14:58										
P16	25/08/13 14:34											
P16	25/08/13 14:53											
P16	25/08/13 15:17											
P16	25/08/13 15:39											
P16	25/08/13 15:54											
P16	25/08/13 16:18											
P16	25/08/13 16:39											
P16	25/08/13 16:57											
P16	25/08/13 17:18											
P16	26/08/13 21:05											
P16	26/08/13 21:21											
P16	26/08/13 21:38											
P16	26/08/13 21:59											
P16	26/08/13 22:19											
P16	26/08/13 22:41											
P16	26/08/13 22:57											
P16	26/08/13 23:19											
P16	26/08/13 23:35											
P16	26/08/13 23:57											
P16	27/08/13 15:17											
P16	27/08/13 15:42											
P16	27/08/13 16:05	27/08/13 16:05	5	4	4	4	5	5	4	3	4	3
P16	27/08/13 16:23											
P16	27/08/13 16:47											
P16	27/08/13 17:11											
P16	27/08/13 17:29											
P16	27/08/13 17:54											

P16	27/08/13 18:10											
P16	27/08/13 18:25											
P16	27/08/13 18:44											
P16	27/08/13 19:08											
P16	27/08/13 19:33											
P16	27/08/13 19:58											
P16	27/08/13 20:20	27/08/13 20:20	4	4	4	5	5	4	4	3	4	4
P16	27/08/13 20:44	27/08/13 20:44	4	4	4	5	5	4	4	3	4	4
P16	29/08/13 11:59											
P16	29/08/13 12:18											
P16	29/08/13 12:39											
P16	29/08/13 12:56											
P16	29/08/13 13:15											
P16	29/08/13 13:33											
P16	29/08/13 13:52											
P16	29/08/13 14:10											
P16	29/08/13 14:31											
P16	29/08/13 14:47											

P17	07/08/13 14:01											
P17	07/08/13 14:22											
P17	07/08/13 14:47	07/08/13 14:47	5	4	2	5	5	5	4	2	2	3
P17	07/08/13 15:07											
P17	07/08/13 15:24											
P17	07/08/13 15:45	07/08/13 15:47	4	4	2	4	5	5	4	2	2	3
P17	07/08/13 16:03	08/08/13 16:04	4	3	2	4	5	5	4	2	2	3
P17	07/08/13 16:18											
P17	07/08/13 16:35	07/08/13 16:36	4	3	2	3	5	5	4	2	2	3
P17	07/08/13 16:58	07/08/13 16:59	4	3	2	5	5	5	4	2	2	3
P17	07/08/13 17:22											
P17	07/08/13 17:42											
P17	07/08/13 17:58											
P17	07/08/13 22:10	07/08/13 22:15	5	3	2	4	5	5	4	1	1	4
P17	07/08/13 22:33											
P17	07/08/13 22:58											
P17	07/08/13 23:18											
P17	07/08/13 23:35											
P17	07/08/13 23:59											
P17	09/08/13 10:45											
P17	09/08/13 11:01											
P17	09/08/13 11:16											
P17	09/08/13 11:34											
P17	09/08/13 11:51											
P17	09/08/13 12:15	09/08/13 12:17	5	3	2	2	5	5	4	1	2	4
P17	09/08/13 12:33	09/08/13 12:33										
P17	09/08/13 12:55											
P17	09/08/13 13:15											
P17	09/08/13 13:34											
P17	09/08/13 13:57											
P17	09/08/13 14:15											
P17	09/08/13 14:37											
P17	09/08/13 14:57											
P17	09/08/13 15:21											
P17	09/08/13 15:39											
P17	09/08/13 15:55	09/08/13 15:58	4	2	2	2	5	5	4	2	1	4
P17	10/08/13 13:36	10/08/13 13:36	5	3	2	3	5	5	4	2	1	4
P17	10/08/13 14:01	10/08/13 14:02	4	2	2	2	5	5	4	1	1	4
P17	10/08/13 14:16											
P17	10/08/13 14:37	10/08/13 14:47										
P17	10/08/13 14:53	10/08/13 14:59										
P17	10/08/13 15:15											
P17	10/08/13 15:32											
P17	10/08/13 15:51											
P17	10/08/13 16:09											
P17	10/08/13 16:28											

P18	04/09/13 15:38	04/09/13 15:38	5	5	3	3	5	3	3	4	3	5
P18	04/09/13 15:58	04/09/13 15:58	4	5	3	5	5	5	5	3	4	5
P18	04/09/13 16:21	04/09/13 16:21	5	2	1	5	5	3	3	3	1	1
P18	04/09/13 16:39	04/09/13 16:39	5	5	5	4	5	5	3	3	5	5
P18	04/09/13 16:56											
P18	04/09/13 17:18											
P18	04/09/13 17:39											
P18	04/09/13 17:55	04/09/13 17:56	2	1	1	4	5	1	4	3	3	2
P18	04/09/13 18:11	04/09/13 18:11	5	5	4	5	5	3	5	5	5	5
P18	04/09/13 18:29	04/09/13 18:37	5	2	2	5	5	4	4	5	2	2
P18	04/09/13 18:48	04/09/13 18:51	1	3	1	5	5	2	3	1	1	1
P18	04/09/13 19:04											
P18	04/09/13 19:20											
P18	04/09/13 19:38											
P18	04/09/13 20:02	04/09/13 20:19	5	3	5	5	4	5	5	5	4	4
P18	04/09/13 20:20	04/09/13 20:32	5	5	4	5	5	5	4	5	5	4
P18	04/09/13 20:37											
P18	04/09/13 21:01											
P18	04/09/13 21:26											
P18	04/09/13 21:44											
P18	04/09/13 22:00											
P18	04/09/13 22:21											
P18	04/09/13 22:37											
P18	04/09/13 22:54											
P18	04/09/13 23:11											
P18	05/09/13 08:55	05/09/13 09:00	5	5	4	5	5	5	4	4	4	4
P18	05/09/13 09:19	05/09/13 09:26	5	5	5	5	5	4	5	5	5	3
P18	05/09/13 09:36											
P18	05/09/13 09:56											
P18	05/09/13 10:12											
P18	05/09/13 10:36											
P18	05/09/13 10:58											
P18	05/09/13 11:21											
P18	05/09/13 11:39											
P18	05/09/13 12:02											
P18	05/09/13 12:23											
P18	05/09/13 12:45											
P18	05/09/13 13:04											
P18	05/09/13 13:20											
P18	05/09/13 13:40											
P18	05/09/13 14:01											
P18	05/09/13 14:18	05/09/13 14:20	5	3	5	5	5	4	4	5	5	5
P18	05/09/13 14:37											
P18	05/09/13 14:57											
P18	05/09/13 15:18	05/09/13 15:25	5	5	2	5	5	5	5	4	5	5
P18	05/09/13 15:35											
P18	05/09/13 15:51	05/09/13 15:51	5	5	5	5	5	5	5	1	5	5
P18	05/09/13 16:09											

P18	05/09/13 16:28											
P18	05/09/13 16:50											
P18	05/09/13 17:12											
P18	05/09/13 17:35	05/09/13 17:35	5	5	5	5	5	4	5	1	5	4
P18	05/09/13 17:57											
P18	05/09/13 18:16											
P18	05/09/13 18:41											
P18	05/09/13 18:58											
P18	05/09/13 19:21											
P18	05/09/13 19:45											
P18	05/09/13 20:06											
P18	05/09/13 20:29											
P18	05/09/13 20:48											
P18	06/09/13 10:19	06/09/13 10:19	5	5	1	5	5	5	5	3	5	5
P18	06/09/13 10:39											
P18	06/09/13 10:55	06/09/13 10:55	5	5	5	5	5	5	5	5	4	4
P18	06/09/13 11:11											
P18	06/09/13 11:29											
P18	06/09/13 11:47											
P18	06/09/13 12:03											
P18	06/09/13 12:18											
P18	06/09/13 12:37											

P19	05/09/13 08:13										
P19	05/09/13 08:36										
P19	05/09/13 08:55										
P19	05/09/13 09:17										
P19	05/09/13 09:37										
P19	05/09/13 09:56										
P19	05/09/13 10:14										
P19	05/09/13 10:31										
P19	05/09/13 10:54	05/09/13 10:54	3	3	4	5	4	4	4	5	5	5
P19	05/09/13 11:11	05/09/13 11:11	4	4	4	5	5	5	4	5	5	5
P19	05/09/13 11:28											
P19	05/09/13 11:47											
P19	05/09/13 12:04											
P19	05/09/13 12:24											
P19	05/09/13 12:44	05/09/13 14:02										
P19	05/09/13 13:08											
P19	05/09/13 13:23											
P19	05/09/13 13:43											
P19	05/09/13 14:02											
P19	07/09/13 15:21											
P19	07/09/13 15:37	07/09/13 15:37	4	5	5	4	5	5	4	4	4	5
P19	07/09/13 15:58											
P19	07/09/13 16:15											
P19	07/09/13 16:32											
P19	07/09/13 16:51											
P19	07/09/13 17:12											
P19	07/09/13 17:34											
P19	07/09/13 17:51											
P19	07/09/13 18:14											
P19	07/09/13 18:35											
P19	12/09/13 10:09											
P19	12/09/13 10:26											
P19	12/09/13 10:42											
P19	12/09/13 10:58											
P19	12/09/13 11:15											
P19	12/09/13 11:38											
P19	12/09/13 11:58											
P19	12/09/13 12:14											
P19	12/09/13 12:36											
P19	12/09/13 12:54											
P19	12/09/13 14:51	12/09/13 14:51	5	5	5	5	5	5	4	4	4	5
P19	12/09/13 15:08											
P19	12/09/13 15:32											
P19	12/09/13 15:55	13/09/13 15:55	5	5	5	5	5	5	4	4	4	5
P19	12/09/13 16:14											
P19	12/09/13 16:36											
P19	12/09/13 16:56											
P19	12/09/13 17:14											

P19	12/09/13 17:37											
P19	12/09/13 17:59											

P20	04/09/13 15:13	04/09/13 15:17	5	4	3	5	2	3	4	4	5	5
P20	04/09/13 15:34	04/09/13 15:34	5	5	4	5	5	3	3	3	5	5
P20	04/09/13 15:51	04/09/13 15:51	5	3	5	5	5	4	3	5	5	4
P20	04/09/13 16:12											
P20	04/09/13 16:34											
P20	04/09/13 16:56											
P20	04/09/13 17:20											
P20	04/09/13 17:43											
P20	04/09/13 18:03											
P20	04/09/13 18:19											
P20	04/09/13 18:39	04/09/13 21:03	5	4	5	5	5	5	3	4	4	4
P20	04/09/13 21:24											
P20	04/09/13 21:49											
P20	04/09/13 22:10											
P20	04/09/13 22:31											
P20	04/09/13 22:50											
P20	04/09/13 23:10											
P20	04/09/13 23:31											
P20	04/09/13 23:51											
P20	05/09/13 00:07											
P20	05/09/13 10:50	05/09/13 10:52	5	5	4	4	1	2	3	5	5	3
P20	05/09/13 11:24											
P20	05/09/13 11:46											
P20	05/09/13 12:09											
P20	05/09/13 12:25											
P20	05/09/13 12:46											
P20	05/09/13 13:01											
P20	05/09/13 13:17											
P20	05/09/13 13:32											
P20	05/09/13 13:50											
P20	05/09/13 14:11											

P21	04/09/13 15:17											
P21	04/09/13 15:33											
P21	04/09/13 15:54	04/09/13 15:54	5	4	4	4	5	4	4	4	4	5
P21	04/09/13 16:16	04/09/13 16:16	5	5	5	4	5	4	4	4	4	5
P21	04/09/13 16:40											
P21	04/09/13 16:57											
P21	04/09/13 17:21											
P21	04/09/13 17:43											
P21	04/09/13 18:03											
P21	04/09/13 18:22											
P21	04/09/13 18:43											
P21	04/09/13 20:13											
P21	04/09/13 20:36											
P21	04/09/13 20:53											
P21	04/09/13 21:09	04/09/13 21:09	5	5	5	5	5	4	4	4	5	5
P21	04/09/13 21:26	04/09/13 21:30	5	5	4	5	5	4	4	4	5	5
P21	04/09/13 21:50											
P21	04/09/13 22:08											
P21	04/09/13 22:32											
P21	04/09/13 22:48											
P21	04/09/13 23:08											
P21	04/09/13 23:25											
P21	04/09/13 23:44											

P22	12/10/13 10:25	12/10/13 10:25	5	4	5	5	5	5	4	5	5	5
P22	12/10/13 10:48											
P22	12/10/13 11:06	12/10/13 11:06	5	4	5	5	5	5	5	5	5	5
P22	12/10/13 11:23	12/10/13 11:23	5	4	5	5	5	5	5	5	5	5
P22	12/10/13 11:44	12/10/13 11:46	5	5	5	5	5	5	5	5	5	5
P22	12/10/13 12:03	12/10/13 12:05	5	5	5	5	5	5	5	5	5	5
P22	12/10/13 12:26	12/10/13 12:38	5	5	5	5	5	5	5	5	5	5
P22	12/10/13 12:46	12/10/13 13:00	5	5	5	5	5	5	5	5	5	5
P22	12/10/13 13:07											
P22	12/10/13 13:25											
P22	12/10/13 13:50	12/10/13 14:06	5	5	5	5	5	5	4	5	5	5
P22	12/10/13 14:09											
P22	12/10/13 14:29											
P22	12/10/13 14:45											
P22	12/10/13 15:09											
P22	12/10/13 15:27											
P22	12/10/13 15:51											
P22	12/10/13 16:08											
P22	12/10/13 16:28											
P22	12/10/13 16:47											

P23	18/10/13 18:49	18/10/13 18:57										
P23	18/10/13 19:10	18/10/13 19:10	5	4	5	5	4	5	5	5	5	4
P23	18/10/13 19:27											
P23	18/10/13 19:49											
P23	18/10/13 20:09											
P23	18/10/13 20:32	18/10/13 20:33										
P23	18/10/13 20:55											
P23	18/10/13 21:15											
P23	18/10/13 21:35											
P23	18/10/13 21:52											
P23	18/10/13 22:10											
P23	19/10/13 14:32	19/10/13 14:32	5	5	5	5	5	5	5	5	5	5
P23	19/10/13 14:55											
P23	19/10/13 15:19											
P23	19/10/13 15:42											
P23	19/10/13 16:00											
P23	19/10/13 16:15	19/10/13 16:16	4	4	5	5	5	4	4	4	4	5
P23	19/10/13 16:41	19/10/13 16:41										
P23	19/10/13 16:58											
P23	19/10/13 17:22											
P23	19/10/13 17:42											
P23	19/10/13 18:01											
P23	19/10/13 18:26											
P23	19/10/13 18:49											
P23	19/10/13 19:05											
P23	19/10/13 19:24											
P23	19/10/13 19:44											
P23	19/10/13 20:06											
P23	21/10/13 20:31	21/10/13 20:31	5	4	4	5	4	4	5	5	5	4
P23	21/10/13 20:49											
P23	21/10/13 21:05											
P23	21/10/13 21:24											
P23	21/10/13 21:41											
P23	21/10/13 22:00											
P23	21/10/13 22:22											
P23	21/10/13 22:45											
P23	21/10/13 23:05											
P23	21/10/13 23:28											
P23	22/10/13 15:21											
P23	22/10/13 15:41											
P23	22/10/13 16:02											
P23	22/10/13 16:25											
P23	22/10/13 16:43											
P23	22/10/13 17:07	22/10/13 17:15	4	4	5	5	4	4	4	4	4	4
P23	22/10/13 17:29											
P23	22/10/13 17:44											
P23	22/10/13 18:01											
P23	22/10/13 18:19											

P23	22/10/13 18:40											
P23	22/10/13 19:01											
P23	22/10/13 19:22											
P23	22/10/13 19:39											
P23	22/10/13 20:03											
P23	22/10/13 20:27											
P23	23/10/13 17:45	23/10/13 17:50	4	3	4	5	4	4	4	5	4	4
P23	23/10/13 18:04	23/10/13 18:04	4	3	4	5	4	4	4	5	4	5
P23	23/10/13 18:20											
P23	23/10/13 18:37											
P23	23/10/13 18:55											
P23	23/10/13 19:11											
P23	23/10/13 19:30											
P23	23/10/13 19:45											
P23	23/10/13 20:04											
P23	23/10/13 20:29											
P23	23/10/13 20:44											
P23	23/10/13 21:02											

P24	18/10/13 21:08											
P24	18/10/13 21:27	18/10/13 21:38	3	2	3	4	2	1	3	5	2	3
P24	18/10/13 21:45											
P24	18/10/13 22:05	18/10/13 22:06	1	1	2	4	2	3	2	5	3	2
P24	18/10/13 22:23											
P24	18/10/13 22:41											
P24	18/10/13 23:02											
P24	18/10/13 23:26											
P24	18/10/13 23:46											
P24	19/10/13 20:26	19/10/13 20:26	4	3	3	3	4	3	3	3	2	2
P24	19/10/13 20:51											
P24	19/10/13 21:07											
P24	19/10/13 21:26											
P24	19/10/13 21:42											
P24	19/10/13 22:01											
P24	19/10/13 22:20											
P24	19/10/13 22:36											
P24	19/10/13 22:55											
P24	19/10/13 23:13											
P24	21/10/13 21:19	21/10/13 21:35	2	2	2	4	3	2	3	2	2	2
P24	21/10/13 21:36											
P24	21/10/13 21:59											
P24	21/10/13 22:23											
P24	21/10/13 22:45											
P24	21/10/13 23:07											
P24	21/10/13 23:23											
P24	21/10/13 23:47											
P24	22/10/13 00:07											
P24	22/10/13 00:23											
P24	24/10/13 20:47	24/10/13 21:04	3	4	3	3	3	2	3	4	3	3
P24	24/10/13 21:12											
P24	24/10/13 21:31											
P24	24/10/13 21:47											
P24	24/10/13 22:03											
P24	24/10/13 22:23											
P24	24/10/13 22:41											
P24	24/10/13 23:00											
P24	24/10/13 23:24											
P24	24/10/13 23:40											
P24	27/10/13 20:57	27/10/13 20:58	3	2	2	3	3	3	3	2	3	2
P24	27/10/13 21:19	27/10/13 21:20	4	3	3	3	3	2	4	3	2	2
P24	27/10/13 21:36											
P24	27/10/13 22:01											
P24	27/10/13 22:25											
P24	27/10/13 22:41											
P24	27/10/13 22:56											
P24	27/10/13 23:13											
P24	27/10/13 23:32											

P24	27/10/13 23:53											
P24	04/11/13 20:59	04/11/13 21:02	4	2	2	4	3	2	4	4	3	3
P24	04/11/13 21:17	04/11/13 21:19	3	3	2	4	3	2	3	3	3	3
P24	04/11/13 21:38	04/11/13 21:44	3	3	2	3	3	3	3	3	3	3
P24	04/11/13 22:00											
P24	04/11/13 22:19											
P24	04/11/13 22:38											
P24	04/11/13 23:00											
P24	04/11/13 23:16											
P24	04/11/13 23:38											
P24	04/11/13 23:58											
P24	05/11/13 00:14											
P24	05/11/13 00:35											
P24	05/11/13 20:43	05/11/13 20:43	3	3	3	3	3	3	3	3	3	3
P24	05/11/13 21:02											
P24	05/11/13 21:24	05/11/13 21:29	3	2	2	4	3	3	3	4	3	3
P24	05/11/13 21:44	05/11/13 21:49	2	3	2	3	3	2	3	3	3	2
P24	05/11/13 22:02											
P24	05/11/13 22:26											
P24	05/11/13 22:47											
P24	05/11/13 23:11											
P24	05/11/13 23:31											
P24	05/11/13 23:51											
P24	06/11/13 00:07											
P24	08/11/13 22:12	08/11/13 22:12	2	2	3	4	3	3	3	3	3	3
P24	08/11/13 22:27											
P24	08/11/13 22:48											
P24	08/11/13 23:04											
P24	12/11/13 21:26	12/11/13 21:33	3	3	2	4	2	4	3	3	5	2
P24	12/11/13 21:44											
P24	12/11/13 22:03	12/11/13 22:05	3	3	2	4	4	3	3	3	3	3
P24	12/11/13 22:27											
P24	12/11/13 22:50											
P24	12/11/13 23:15											
P24	12/11/13 23:34											
P24	12/11/13 23:55											
P24	17/11/13 12:23											
P24	17/11/13 12:41	17/11/13 12:46	3	3	2	4	3	3	3	3	2	3
P24	17/11/13 12:56	17/11/13 13:03	3	3	3	3	3	3	4	3	3	3
P24	17/11/13 13:15											
P24	17/11/13 13:35											
P24	17/11/13 13:53											
P24	17/11/13 14:13											
P24	17/11/13 14:35											
P24	17/11/13 14:59	19/11/13 15:00	2	3	2	3	2	3	2	3	2	3
P24	17/11/13 15:16	27/11/13 15:18	2	4	2	4	2	4	2	4	2	3
P24	17/11/13 22:34											
P24	17/11/13 22:52											

P24	17/11/13 23:15											
P24	17/11/13 23:38											
P24	17/11/13 23:53											

P26	21/10/13 19:24	21/10/13 19:24	4	4	4	4	5	5	5	4	4	3
P26	21/10/13 19:45											
P26	21/10/13 20:06											
P26	21/10/13 20:24	21/10/13 20:24	5	3	4	4	5	4	5	5	5	3
P26	21/10/13 20:46											
P26	21/10/13 21:06											
P26	21/10/13 21:28											
P26	21/10/13 21:50											
P26	21/10/13 22:14											
P26	21/10/13 22:31											
P26	22/10/13 07:07	22/10/13 07:17	5	3	3	5	5	5	5	5	5	5
P26	22/10/13 07:29	22/10/13 07:30	5	3	4	4	5	5	5	4	3	4
P26	22/10/13 07:45											
P26	22/10/13 08:07											
P26	22/10/13 08:31											
P26	22/10/13 08:54											
P26	22/10/13 09:14											
P26	22/10/13 09:31											
P26	22/10/13 09:56											
P26	22/10/13 10:16	22/10/13 10:19	5	4	5	4	5	5	5	5	5	5
P26	22/10/13 10:32	22/10/13 10:33	5	4	5	4	5	5	5	5	5	5
P26	22/10/13 10:54	22/10/13 10:56	5	4	5	4	5	5	5	5	5	5
P26	22/10/13 16:58	22/10/13 16:58	5	4	5	5	5	5	5	5	4	4
P26	22/10/13 17:17	22/10/13 17:18	4	4	5	4	5	5	5	5	4	4
P26	22/10/13 17:35											
P26	22/10/13 17:51											
P26	22/10/13 18:12	22/10/13 18:13	5	4	5	4	5	5	5	5	5	5
P26	22/10/13 18:34	22/10/13 18:34	5	4	5	4	5	5	5	5	5	5
P26	22/10/13 18:53	22/10/13 18:54	4	4	5	4	5	5	5	5	4	5
P26	22/10/13 19:15	22/10/13 19:21	4	4	5	4	5	5	5	5	4	5
P26	22/10/13 19:34											
P26	22/10/13 19:59											
P26	22/10/13 20:22											
P26	22/10/13 20:39											
P26	22/10/13 20:56											
P26	22/10/13 21:18	26/10/13 21:19	4	4	5	5	5	5	5	5	5	5
P26	22/10/13 21:35	26/10/13 21:35	4	4	5	5	5	5	5	5	5	5
P26	22/10/13 21:52	26/10/13 21:53	4	5	5	5	5	5	5	5	5	5
P26	22/10/13 22:11	26/10/13 22:11	4	4	5	5	5	5	5	5	4	3
P26	22/10/13 22:30	26/10/13 22:30	4	4	5	5	5	5	5	5	4	3
P26	26/10/13 18:51											
P26	26/10/13 19:11											
P26	26/10/13 19:36											
P26	26/10/13 19:56											
P26	26/10/13 20:11											
P26	26/10/13 20:31	26/10/13 20:32	5	5	5	5	5	5	5	5	5	5
P26	26/10/13 20:55	26/10/13 20:55	5	4	5	5	5	5	5	5	4	5
P26	26/10/13 21:14	26/10/13 21:14	5	4	5	5	5	5	5	5	4	5

P26	26/10/13 21:37	26/10/13 21:38	5	5	5	5	5	5	5	5	5	5
P26	26/10/13 21:55	26/10/13 21:59	5	5	5	5	5	5	5	5	5	5
P26	03/11/13 09:50											
P26	03/11/13 10:10											
P26	03/11/13 10:33											
P26	03/11/13 10:52											
P26	03/11/13 11:13											
P26	03/11/13 11:37	03/11/13 11:38	5	4	5	4	5	5	5	5	4	5
P26	03/11/13 11:59	03/11/13 12:01	5	4	5	4	5	5	5	5	4	5
P26	03/11/13 12:17	03/11/13 12:17	5	5	5	4	5	5	5	5	4	5
P26	03/11/13 12:40	03/11/13 12:40	5	5	5	4	5	5	5	5	4	5
P26	03/11/13 13:02	03/11/13 13:04	5	4	5	4	5	5	5	5	4	5
P26	04/11/13 06:17											
P26	04/11/13 06:32											
P26	04/11/13 06:49											
P26	04/11/13 07:08											
P26	04/11/13 07:27											
P26	04/11/13 07:45											
P26	04/11/13 08:01											
P26	04/11/13 08:21	04/11/13 08:22										
P26	04/11/13 08:36	04/11/13 08:36										
P26	04/11/13 08:57											

P27	18/10/13 17:33											
P27	18/10/13 17:49											
P27	18/10/13 18:07	18/10/13 18:10	5	5	3	5	5	5	5	4	5	5
P27	18/10/13 18:23	18/10/13 18:23	5	5	4	5	5	5	5	5	5	5
P27	18/10/13 18:39	18/10/13 18:40	5	5	4	5	5	5	5	4	5	5
P27	18/10/13 19:03											
P27	18/10/13 19:19											
P27	18/10/13 19:41											
P27	18/10/13 19:59											
P27	18/10/13 20:15											
P27	19/10/13 15:30	19/10/13 15:35	5	5	4	5	5	5	5	3	5	5
P27	20/10/13 15:46	20/10/13 15:47	5	5	4	5	5	5	5	4	5	5
P27	21/10/13 16:15											
P27	22/10/13 16:39	22/10/13 16:44	5	5	5	5	5	5	5	4	5	5
P27	23/10/13 16:57	23/10/13 17:01	5	5	5	5	5	5	5	5	5	5
P27	24/10/13 17:17											

P28	25/10/13 15:01											
P28	25/10/13 15:17	25/10/13 15:18	5	4	3	5	5	5	5	5	4	3
P28	25/10/13 15:39	25/10/13 15:39	5	4	3	5	5	3	4	5	5	3
P28	25/10/13 15:56	25/10/13 15:56	5	4	3	5	5	3	4	5	5	3
P28	25/10/13 16:17											
P28	25/10/13 16:38											
P28	25/10/13 16:54											
P28	25/10/13 17:09											
P28	25/10/13 17:34											
P28	25/10/13 17:50											
P28	25/10/13 18:14											
P28	25/10/13 18:38											
P28	25/10/13 21:26											
P28	25/10/13 21:41	25/10/13 21:41	5	4	3	5	5	4	5	5	4	3
P28	25/10/13 22:00											
P28	25/10/13 22:16											
P28	25/10/13 22:38											
P28	25/10/13 22:54											
P28	25/10/13 23:13											
P28	25/10/13 23:33											
P28	25/10/13 23:49											
P28	02/11/13 00:22											
P28	02/11/13 00:40											
P28	02/11/13 09:38	02/11/13 09:38										
P28	02/11/13 10:01	02/11/13 10:01	5	4	3	5	4	3	5	4	3	4
P28	02/11/13 10:21											
P28	02/11/13 10:41											
P28	02/11/13 10:57											
P28	02/11/13 11:16											
P28	02/11/13 11:31											
P28	02/11/13 11:47											
P28	02/11/13 12:06											
P28	02/11/13 12:24											
P28	02/11/13 12:41											
P28	12/11/13 10:51	12/11/13 10:51	5	4	3	5	4	3	5	4	3	4
P28	12/11/13 11:16											
P28	12/11/13 11:36											
P28	12/11/13 11:52											
P28	12/11/13 12:09											
P28	12/11/13 12:26											
P28	12/11/13 12:42											
P28	12/11/13 12:59											
P28	12/11/13 13:17											
P28	12/11/13 13:41											
P28	12/11/13 14:06											
P28	14/11/13 10:27											
P28	14/11/13 10:47											
P28	14/11/13 11:07											

P28	14/11/13 11:24											
P28	14/11/13 11:47											
P28	14/11/13 12:12											
P28	14/11/13 12:29											
P28	14/11/13 12:50											
P28	14/11/13 13:11											
P28	14/11/13 13:34											
P28	14/11/13 14:19	14/11/13 14:19	5	4	3	5	4	3	5	4	3	4
P28	14/11/13 14:34	14/11/13 14:34	5	4	3	5	4	3	5	4	3	4
P28	14/11/13 14:58											
P28	14/11/13 15:18											
P28	14/11/13 15:40											
P28	14/11/13 15:56											
P28	14/11/13 16:18											
P28	14/11/13 16:43											
P28	14/11/13 17:00											
P28	14/11/13 17:17											
P28	14/11/13 17:42											
P28	14/11/13 17:59											

P29	15/11/13 18:03											
P29	15/11/13 18:26											
P29	15/11/13 18:50	15/11/13 18:50	4	4	4	5	4	4	4	4	4	3
P29	15/11/13 19:09											
P29	15/11/13 19:33	15/11/13 19:33	4	4	4	5	4	4	4	4	4	3
P29	15/11/13 19:53	15/11/13 19:53	4	4	4	4	4	4	4	4	4	3
P29	15/11/13 20:11											
P29	15/11/13 20:36											
P29	15/11/13 21:01											
P29	15/11/13 21:17											
P29	16/11/13 18:10	16/11/13 18:10	4	4	4	3	4	4	4	4	4	3
P29	16/11/13 18:26		4	4	4	4	4	4	4	3	4	3
P29	16/11/13 18:43	16/11/13 18:43										
P29	16/11/13 19:08		4	4	4	4	4	4	4	3	4	3
P29	16/11/13 19:32	16/11/13 19:32	4	4	4	4	4	4	4	4	4	3
P29	16/11/13 19:51											
P29	16/11/13 20:09											
P29	16/11/13 20:30											
P29	16/11/13 20:51											
P29	16/11/13 21:13											

P30	18/11/13 14:03											
P30	18/11/13 14:18											
P30	18/11/13 14:43	18/11/13 14:43	5	5	4	5	5	5	5	4	4	4
P30	18/11/13 15:05											
P30	18/11/13 15:26											
P30	18/11/13 15:47											
P30	18/11/13 16:06											
P30	18/11/13 16:24											
P30	18/11/13 16:44											
P30	18/11/13 17:03											
P30	18/11/13 17:24											
P30	18/11/13 17:40											
P30	18/11/13 18:03											
P30	18/11/13 18:25											
P30	19/11/13 14:48											
P30	19/11/13 15:06											
P30	19/11/13 15:29											
P30	19/11/13 15:54											
P30	19/11/13 16:12											
P30	19/11/13 16:34											
P30	19/11/13 16:59											
P30	19/11/13 17:17	19/11/13 17:17	5	5	5	5	5	4	4	5	5	5
P30	19/11/13 17:35											
P30	19/11/13 17:52											
P30	19/11/13 18:15											
P30	22/11/13 14:21											
P30	22/11/13 14:36											
P30	22/11/13 14:57											
P30	22/11/13 15:12											
P30	22/11/13 15:35	22/11/13 15:35	4	4	4	5	5	4	4	4	4	4
P30	22/11/13 15:55											
P30	22/11/13 16:17											
P30	22/11/13 16:41											
P30	22/11/13 17:02											
P30	22/11/13 17:19											
P30	22/11/13 17:37											
P30	23/11/13 14:00											
P30	23/11/13 14:18											
P30	23/11/13 14:39											
P30	23/11/13 15:02											
P30	23/11/13 15:23	23/11/13 15:23	5	4	4	5	5	5	5	5	5	4
P30	23/11/13 15:43											
P30	23/11/13 16:04											
P30	23/11/13 16:26											

P31	15/11/13 14:03										
P31	15/11/13 14:23										
P31	15/11/13 14:47	15/11/13 14:47	5	5	5	5	5	5	5	4	5	5
P31	15/11/13 15:10	15/11/13 15:11	5	5	4	5	5	5	5	4	5	5
P31	15/11/13 15:33											
P31	15/11/13 15:53	15/11/13 15:53	4	5	4	5	5	5	5	4	5	5
P31	15/11/13 16:11	15/11/13 16:12	4	5	4	5	5	5	5	4	5	5
P31	15/11/13 16:35											
P31	15/11/13 16:58	15/11/13 17:30										
P31	15/11/13 17:16											
P31	16/11/13 16:50											
P31	16/11/13 17:14											
P31	16/11/13 17:38	16/11/13 17:49	5	5	3	5	5	5	5	3	5	5
P31	16/11/13 17:53	16/11/13 17:58	5	5	3	5	5	5	5	3	5	5
P31	16/11/13 18:16											
P31	16/11/13 18:37	16/11/13 18:37	5	5	5	5	5	5	5	4	5	5
P31	16/11/13 18:57	16/11/13 18:57	5	5	5	5	5	5	5	5	5	5
P31	16/11/13 19:15											
P31	16/11/13 19:33											
P31	16/11/13 19:55											
P31	16/11/13 20:14											
P31	17/11/13 09:30	17/11/13 09:33	5	5	5	5	5	5	5	5	5	5
P31	17/11/13 09:49	17/11/13 09:49	5	5	5	5	5	5	5	5	5	5
P31	17/11/13 10:11											
P31	17/11/13 10:33											
P31	17/11/13 10:51	17/11/13 10:51	5	5	5	5	5	5	5	5	5	4
P31	17/11/13 11:12	17/11/13 11:12	5	5	5	5	5	5	5	5	5	4
P31	17/11/13 11:29	17/11/13 11:29	5	5	5	4	5	5	5	4	5	4
P31	17/11/13 11:46	17/11/13 11:46	5	5	4	4	5	5	5	4	5	4
P31	17/11/13 16:46											
P31	17/11/13 17:05											
P31	17/11/13 17:31											
P31	17/11/13 17:51											
P31	17/11/13 18:06											
P31	17/11/13 18:26											
P31	20/11/13 18:22											
P31	20/11/13 18:46											
P31	20/11/13 19:05											
P31	20/11/13 19:27											
P31	20/11/13 19:48											
P31	20/11/13 20:09											
P31	20/11/13 20:31											
P31	20/11/13 20:46	20/11/13 20:47										
P31	20/11/13 21:09	20/11/13 21:09	5	5	4	4	4	5	5	3	5	5
P31	20/11/13 21:34											
P31	20/11/13 21:53											

P32	29/11/13 20:50	29/11/13 20:51	5	5	5	5	5	5	4	5	5	5
P32	29/11/13 21:06	29/11/13 21:06	5	5	5	5	5	5	4	5	5	5
P32	29/11/13 21:26	29/11/13 21:27	5	5	5	5	5	5	4	5	5	5
P32	29/11/13 21:52	29/11/13 21:52	5	5	5	5	5	5	4	5	5	5
P32	29/11/13 22:17	29/11/13 22:17	5	5	5	5	5	5	4	5	5	5
P32	29/11/13 22:34											
P32	29/11/13 22:58											
P32	29/11/13 23:14											
P32	29/11/13 23:34											
P32	29/11/13 23:58											
P32	30/11/13 10:24	30/11/13 10:24	5	5	5	5	5	5	5	5	5	5
P32	30/11/13 10:40	30/11/13 10:41	5	5	5	5	5	5	5	5	5	5
P32	30/11/13 10:56	30/11/13 10:56	5	5	5	5	5	5	5	5	5	5
P32	30/11/13 11:14	30/11/13 11:14	5	5	5	5	5	5	5	5	5	5
P32	01/12/13 10:15	01/12/13 10:15	5	5	5	5	5	5	5	5	5	5
P32	01/12/13 10:40	01/12/13 10:42	5	5	4	5	5	5	5	5	5	4
P32	01/12/13 11:02	01/12/13 11:06	5	4	4	5	5	5	5	5	5	4
P32	01/12/13 11:25											
P32	01/12/13 11:47											
P32	01/12/13 12:10											
P32	01/12/13 12:36											
P32	03/12/13 16:21	03/12/13 16:21	5	5	5	5	5	5	5	5	5	4
P32	03/12/13 16:46	03/12/13 16:46	5	5	5	5	5	5	5	5	5	4
P32	03/12/13 17:08	03/12/13 17:09	5	5	5	5	5	5	5	5	5	4
P32	03/12/13 17:32	03/12/13 17:32	5	5	5	5	5	5	5	5	5	4
P32	03/12/13 17:48	03/12/13 17:50	5	4	5	5	5	5	5	5	5	4
P32	03/12/13 18:12	03/12/13 18:13	5	4	5	5	5	5	5	5	5	4
P32	03/12/13 18:32											
P32	03/12/13 18:48											
P32	03/12/13 19:11											
P32	03/12/13 19:30											
P32	03/12/13 19:50											
P32	03/12/13 20:13											

Appendix C

Statistical Tests

In this Appendix we report the output of the statistical tests we performed on the aggregated data (see Chapter 6 for details). All the statistical tests were run using the SPSS Statistics software.

Ratio Statistics for the Control and Experimental Group

Case Processing Summary

		Count	Percent
Group	control	12	42.9%
	experimental	16	57.1%
Overall		28	100.0%
Excluded		4	
Total		32	

Ratio Statistics for Median of the scores / unit

Group	Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound	Actual Coverage
control	40.000	34.000	44.000	96.1%
experimental	48.000	46.000	49.500	97.9%
Overall	46.000	43.000	48.000	96.4%

The confidence interval for the median is constructed without any distribution assumptions.
The actual coverage level may be greater than the specified level.

Table C.1) The median flow scores of the experimental group and the control group together with the approximated 95% confidence interval for the estimated population's median and the actual coverage of the confidence interval

Mann-Whitney-Wilcoxon Test: Control Group versus Experimental Group

Ranks

Group		N	Mean Rank	Sum of Ranks
Median of the scores	control	12	7.92	95.00
	experimental	16	19.44	311.00
	Total	28		

Test Statistics[a]

	Median of the scores
Mann-Whitney U	17.000
Wilcoxon W	95.000
Z	-3.677
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[b]

a. Grouping Variable: Group

b. Not corrected for ties.

Table C.2) The result of the Mann-Whitney U test performed to check for differences in the median flow scores of the control and the experimental group

Mann-Whitney-Wilcoxon Test: Males versus Females

Ranks

Sex		N	Mean Rank	Sum of Ranks
Median of the scores	M	11	17.05	187.50
	F	17	12.85	218.50
	Total	28		

Test Statistics[a]

	Median of the scores
Mann-Whitney U	65.500
Wilcoxon W	218.500
Z	-1.320
Asymp. Sig. (2-tailed)	.187
Exact Sig. [2*(1-tailed Sig.)]	.191[b]

a. Grouping Variable: Sex

b. Not corrected for ties.

Table C.3) The result of the Mann-Whitney U test performed to check for differences in the median flow scores of the participants grouped according to their sex

Kruskal-Wallis Test: Age Groups

Ranks

Age group		N	Mean Rank
Median of the scores	7-8	10	15.95
	9-10	11	15.05
	11-12	7	11.57
	Total	28	

Test Statistics[a,b]

	Median of the scores
Chi-Square	1.252
df	2
Asymp. Sig.	.535

a. Kruskal Wallis Test

b. Grouping Variable: Age group

Table C.4) The result of the Kruskal-Wallis test performed to check for differences in the median flow scores of the participants grouped according to their age

Kruskal-Wallis Test: Use of Tablets

Ranks

Use of tablet		N	Mean Rank
Median of the scores	never	5	10.80
	seldom	7	19.93
	often	16	13.28
	Total	28	

Test Statistics[a,b]

	Median of the scores
Chi-Square	4.433
df	2
Asymp. Sig.	.109

a. Kruskal Wallis Test

b. Grouping Variable: Use of tablet

Table C.5) The result of the Kruskal-Wallis test performed to check for differences in the median flow scores of the participants grouped according to the frequency of their tablets' usage.

Kruskal-Wallis Test: Having Read "The Little Prince"

Ranks

Have ... read the story		N	Mean Rank
Median of the scores	never	13	13.96
	partially	8	12.94
	already	7	17.29
	Total	28	

Test Statistics[a,b]

	Median of the scores
Chi-Square	1.153
df	2
Asymp. Sig.	.562

a. Kruskal Wallis Test

b. Grouping Variable: Have ... read the story

Table C.6) The result of the Kruskal-Wallis test performed to check for differences in the median flow scores of the participants grouped on the basis of whether or not they had already read "The Little Prince" story.

Kruskal-Wallis Test: Typologies of Readers

Ranks

Kind of reader		N	Mean Rank
Median of the scores	weak	6	14.67
	normal	10	12.30
	strong	12	16.25
	Total	28	

Test Statistics[a,b]

	Median of the scores
Chi-Square	1.267
df	2
Asymp. Sig.	.531

a. Kruskal Wallis Test

b. Grouping Variable: Kind of reader

Table C.7) The result of the Kruskal-Wallis test performed to check for differences in the median flow scores of the participants grouped according to their reading frequency.